



DEVELOPMENT OF FEMALE MEDFLY ATTRACTANTS TO SUPPORT THE STERILE INSECT TECHNIQUE: EXPERIMENTS CONDUCTED IN MADEIRA, PORTUGAL

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Abstract

With the availability of genetic sexing strains of Mediterranean fruit fly, *Ceratitis capitata* (Wied.), it is possible to release only sterile males in SIT programs. The availability of a new female medfly attractant can reduce labor costs because program progress can be monitored by trapping females instead of the usual male trapping with its labor intensive identification of sterile and wild males. Three Madeira studies evaluated new female attractants; ammonium acetate, putrescine and trimethylamine. One study was carried out in the same area during two different periods of 1996 (8 June to 27 July and 12 October to 30 November). A second study was conducted between 24 May to 05 July, 1997, in two different areas at the same altitude. One area had a wild fly population (sex ratio 1:1) and the other was in an area where sterile males were released (sex ratio > 9:1). The third study, conducted from 18 October to 29 November, 1997, compared wild fly captures at low elevations (80m) with those at high elevations (700m). The first study showed that the inclusion of the attractant trimethylamine significantly increased the wild female medfly. The percentage of medfly females in the traps with the two and the three attractants (FA-2 and FA-3) was more than 70%. In the second and third studies, the dry traps were more effective than wet traps in capturing wild medfly females. In areas with only wild females, the percentage of females captured was more than 62%. In areas where sterile males were released, the percentage of females captured was between 12% and 19%. In conclusion, the new attractants captured high percentages of females and, when combined with medfly genetic sexing strains, can reduce program costs significantly.

1. INTRODUCTION

The work reported here is part of the FAO/IAEA Co-ordinated Research Programme (CRP) entitled "Development of Female Medfly Attractant Systems for Trapping and Sterility Assessment."

The objective of this CRP was to develop a trapping system for female medflies which could be used in practical Sterile Insect Technique (SIT) programmes where medfly genetic sexing strains are used [1], in detection programmes based on capturing female medflies, and in suppression programmes using female traps for mass trapping [2].

In Madeira, a SIT programme for medfly control has been started using a temperature sensitive lethal (*tsl*) strain, for release of sterile males only [3]. If a suitable female medfly trapping system were available, it could be used in association with SIT to suppress female medfly populations by mass trapping prior to the release of sterile males and to monitor feral populations. One of these methods is mass trapping combined with post-harvest removal of fruit fly hosts [4]. Mass trapping of females, using the new female attractants, would enhance population suppression before the release of sterile males.

2. MATERIALS AND METHODS

Madeira (32°N, 17°W) is located 980 km WSW of mainland Portugal. Its two principal islands, Porto Santo (50 km²) and Madeira (740 km²), are populated by 255,000 people and fruit and vegetable production is widespread. The climate of Madeira is variable, depending upon altitude and northern/southern aspect. On the whole, climate is moderated by the effects of the surrounding sea.

The studies were done on the southern coast of Madeira (Fig. 1). The first study in Ribeira Brava Valley (0-160 m altitude) during two seasons assessed wild medfly phenology, the second study in Ribeira Brava Valley assessed the effect of sterile releases on the wild medfly population (Quebradas, 80 m altitude) and the third study compared wild medfly populations at low elevations (Quebradas) with populations at higher elevations (Camacha, 700 m altitude).

Hourly climatic data were obtained from automatic climate stations near the test areas. The data included daily maximum, minimum and average temperatures and relative humidity and daily rainfall.

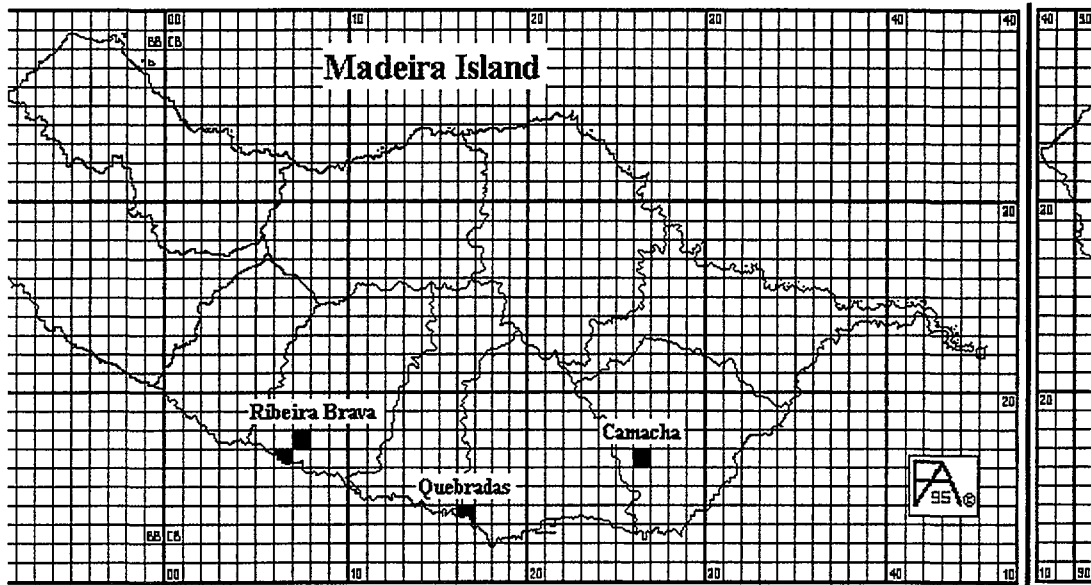


Fig. 1-Location where the studies were done on Madeira Island (first: Ribeira Brava; second: Ribeira Brava and Quebradas; third: Quebradas and Camacha).

2.1. Study One - 1996

This study was conducted in the same area of Ribeira Brava during two different periods (period 1: 8 June-27 July, 1996, and period 2: 11 October-30 November, 1996).

Each experiment consisted of five blocks, with 7 different types of traps in each. The traps were rotated weekly within blocks and trap captures were assessed twice a week for 7 weeks.

The traps and attractants used are described below:

- Jackson trap (JT). This trap has a standard sticky insert, baited with a Trimedlure (TML) plug placed in a plastic basket hung inside the trap in the middle of the horizontal wire hanger. The sticky insert was replaced weekly and the TML plug replaced every two weeks.
- Open bottom dry trap (OBDT, FA-2) [5]. This trap has an open bottom and a yellow sticky insert to capture flies, and was baited with ammonium acetate and putrescine (FA-2 attractants). The yellow sticky insert was replaced weekly, and the FA-2 lure replaced monthly.

- Open bottom dry trap (OBDT, FA-3) [5]. This trap was the same as above except it was baited with ammonium acetate, putrescine and trimethylamine (FA-3 attractants).
- Cooperators Choice (CC-2) - Period 1: The JT, with the standard sticky insert, was baited with FA-2 attractants. The sticky insert was replaced weekly, and baits replaced monthly.
Period 2: The trap was a yellow container with holes in the bottom [3]. The toxicant, sugar mixed with fention, was placed inside the trap which was baited with FA-2 attractants. The sugar/toxicant was replaced biweekly, and baits replaced monthly.
- (CC-3) - This was the same trap as above, except baited with the FA-3 attractants.
- Tephri trap (Tephri, NU+B). This Spanish version of the plastic McPhail trap was baited with 300 ml of an aqueous solution containing 9% NuLure and 3% borax (NU+B). The bait was replaced weekly.
- Fructet trap and lure. This red spherical container has a special bait and one yellow display board suspended from the sphere. There was a yellow panel coated with sticky material to trap the medflies. This panel was replaced weekly.

2.2. Studies Two and Three - 1997

The second study was conducted in different areas at the same altitude (80 m) with two different wild fly densities. It compared natural wild fly population growth with the release of sterile males using ground release techniques (sex ratio > 9:1), between 24 May to 05 July, 1997.

Ground releases from paper bags were carried out twice a week (1000 fliers by hectare). The released flies were two day old sterile males only. The person who released the flies had no knowledge of the trap locations.

The third study was conducted in different areas to compare wild medfly captures at low elevations (80 m) and high elevations (700 m) (18 October-30 November, 1997).

Each study consisted of five blocks, with 6 different types of traps in each block. The traps were rotated weekly within blocks. Each study ran for 6 weeks. All traps were serviced twice per week. The bait in the IPMT, NU+B traps was replaced weekly. The FA-3 attractants were not replaced during the course of the study. The traps and attractants used in both studies are described below:

- The International Pheromone's McPhail trap (IPMT) was baited with 300 ml of NU+B. The bait was replaced weekly.
- Open bottom dry trap with FA-3 attractants (OBDT, FA-3) had a yellow sticky insert to capture flies. The insert was replaced weekly.
- The Tephri trap with FA-3 attractants (Tephri, FA-3, wet), when used as a wet trap, contained 200 ml of water and surfactant. This solution was replaced weekly.
- The Tephri trap with FA-3 attractants (Tephri, FA-3, dry), when used as a dry trap, contained DDVP in its base.
- The IPMT with FA-3 attractants (IPMT, FA-3, wet), when used as a wet trap, contained 300 ml of water and surfactant in its base. This solution was replaced weekly.
- The IPMT with FA-3 attractants (IPMT, FA-3, dry), when used as a dry trap, contained DDVP in its base.

3. RESULTS AND DISCUSSION

Data from each study was analyzed using analysis of variance and Duncan's multiple range test for comparison of averages [6].

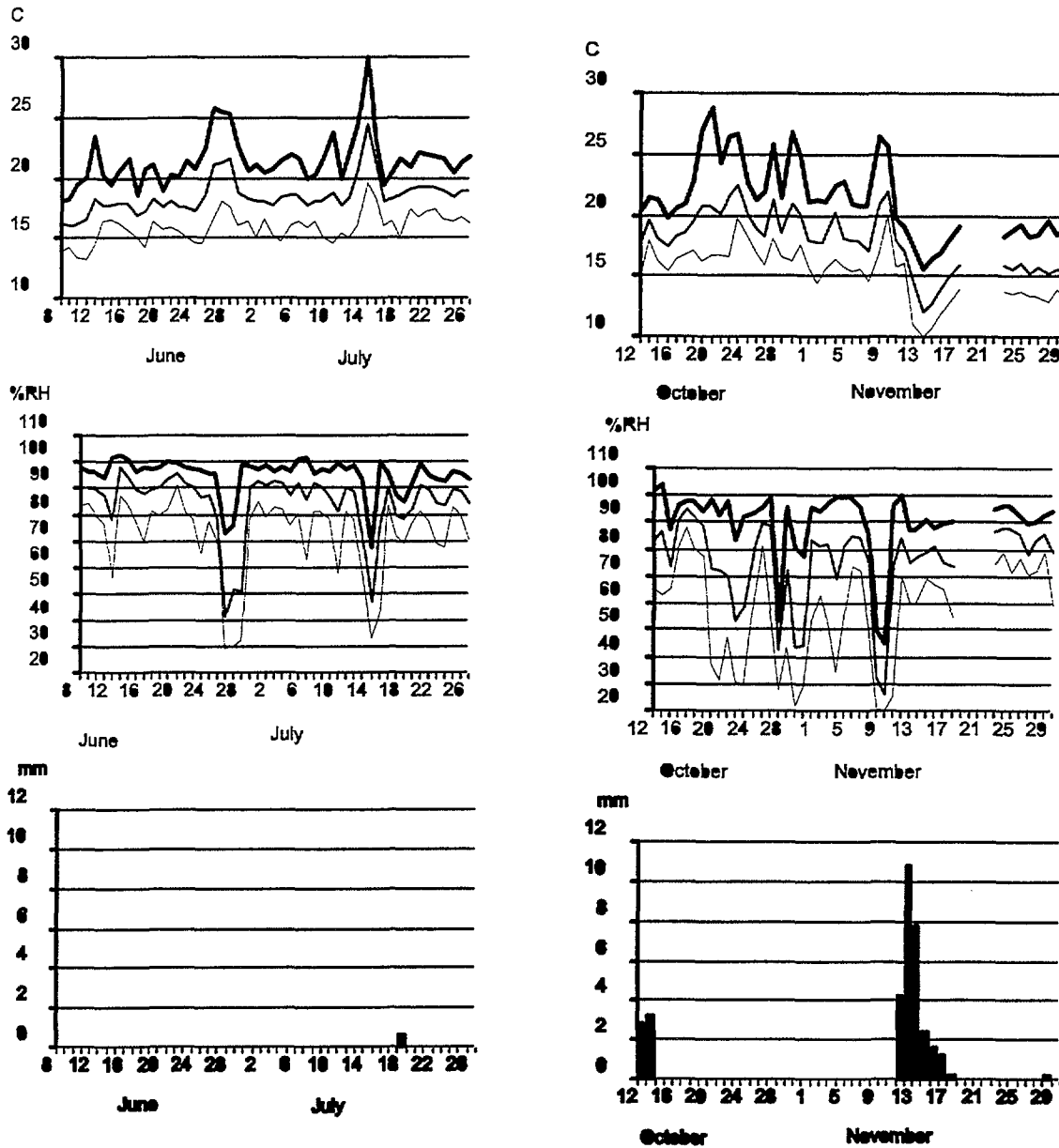


Fig. 2-Climata data during the first study: *left column* - period 1 (8 June-27 July, 1996); *right column*- period 2 (12 October- 30 November); *top* - daily temperature (maximum, mean and minimum); *middle* - relative humidity (maximum, mean and minimum); *bottom* - rainfall.

3.1. Study One - 1996

Fig. 2 shows temperature (maximum, mean and minimum), relative humidity (maximum, mean and minimum) and rainfall data for the two different periods.

During period 1 (8 June-27 July, 1996) the minimum temperature fluctuated between 13 - 20 °C with most days about 15 °C. The maximum daily temperatures ranged from 18 - 30 °C with an average of 21.45 ± 2.11 °C. The relative humidity (RH) was greater than 60% during nearly all of the test period (Fig. 2). Rain occurred for only 1 day, with a total of 0.6mm.

During period 2 (11 October-30 November, 1996) temperatures during the first 4 weeks were similar to period 1, but decreased during the last three weeks of the study. The RH was lower than in the first period and rain occurred on 10 days, with a total of 34.4mm (Fig. 2). Data from four days are missing because of battery failure in the automatic climate measuring device.

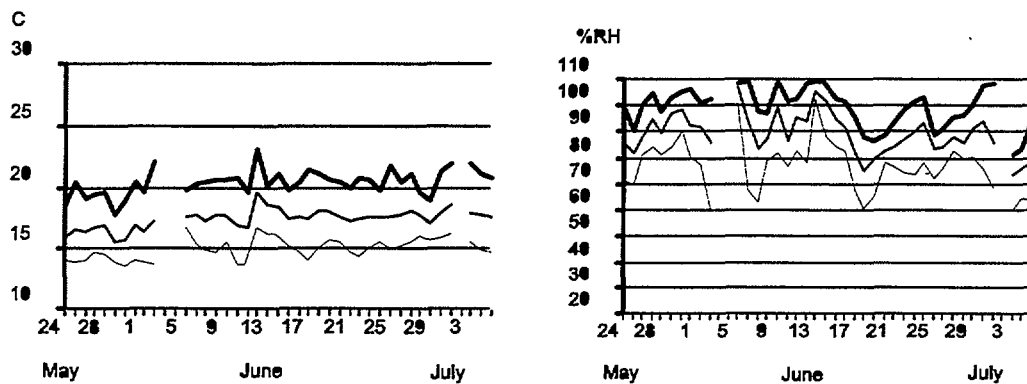
The wild medfly capture data for both periods were very different. Tables I and II show the number of flies/trap/day (F/T/D) and the percentage of the females by week. The last three columns show average F/T/D, % females captured and the total number of adult medfly captured.

In period 1, the JT, TML was the most effective, capturing 2128 flies, of which only 2 were female, compared to the OBDT, FA-3 which captured 295 flies, of which 183 were female (Table I). Although the JT, TML removed 7 times more flies from the overall population, the OBDT, FA-3 removed 90 times more females (potentially lowering the progeny going to the next generation) from the population than did the JT, TML [7].

Wild medfly capture during period 2 demonstrated a higher medfly population than period 1 (Table II). While the JT, TML was again the most effective (7367 flies captured), the OBDT, FA-3 caught 2271 flies. The JT caught about 20 females, while the OBDT, FA-3 trapped about 1770 females. As in period 1, the OBDT, FA-3 removed about 90 times more females from the medfly population than did the JT, TML.

During period 2, wild medfly captures were higher during the first four weeks than during the last three, probably because of higher temperatures. Traps baited with the new female attractants, showed significant decreases in captures as temperature decreased, and is similar to data reported by [8].

During both periods, the addition of TMA to AA+P (FA-3 attractants) enhanced the capture of wild female medflies and is clearly shown in the data (Tables I and II). This data is also similar to that of [9].



3.2. Study Two - 1997

Fig. 3 shows temperature (maximum, mean and minimum), relative humidity (maximum, mean and minimum) and rainfall data during the time of the study and close to the study areas.

During the second study (24 May-5 July, 1997), the minimum temperature fluctuated between 14 -17° C with most days about 15° C. The maximum daily temperatures ranged from 18 - 23 °C with an average of 20.38 ± 1.06 °C. The relative humidity was high during nearly all of the test period. Rain occurred on 16 days, with a total of 51.2mm. Three days of data are missing because of battery failure in the automatic climate measuring device.

TABLE I. CAPTURE OF ADULT MEDFLIES IN F/T/D, PERCENT FEMALES AND TOTAL FLIES (EXPERIMENT 1: 8 JUNE - 27 JULY, 1996)

Trap	Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Week 7		Total		
	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	Flies
JT, TML	1.11b	0.00	0.14a	0.28	7.17a	0.40	4.09a	0.00	5.97a	0.00	14.91a	0.00	17.40a	3.45	7.26±6.60a	1.08	2128
OBDT,FA-2	0.20c	85.71	0.00d	-	0.00c	-	0.03e	0.00	0.06d	50.00	0.66cd	60.87	1.34b	65.96	0.33±0.50c	65.0	80
OBDT,FA-3	0.00d	-	0.00d	-	0.00c	-	0.00e	-	0.09d	100.0	7.57b	43.40	0.77bc	77.78	1.20±2.82b	62.0	295
CC, FA-2	0.03d	100.0	0.00d	-	0.00c	-	1.31b	78.28	0.71c	0.00	1.03c	47.22	1.46b	19.61	0.65±0.64c	46.3	138
CC, FA-3	0.00d	-	0.00d	-	0.00c	-	0.46c	68.75	1.31b	39.13	2.46c	56.98	2.69b	48.94	0.99±1.18b	51.2	242
Tephri, NU+B	0.40d	92.86	1.09c	94.74	0.03c	100.0	0.09de	66.67	0.69c	50.00	0.17d	33.33	0.03c	100.0	0.36±0.40c	77.0	87
Frutect	3.77a	90.15	0.23b	62.50	0.35b	52.82	0.18d	88.89	0.14d	42.86	0.14d	42.86	0.76bc	64.86	0.80±1.33b	78.3	217

*the data with the same letter in each column have no significant differences (Duncan's multiple range test, P=0.05)

TABLE II. CAPTURE OF ADULT MEDFLIES IN F/T/D, PERCENT FEMALES AND TOTAL FLIES (EXPERIMENT 2: 12 OCTOBER-30 NOVEMBER, 1996)

Trap	Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Week 7		Totals		
	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	Flies
JT, TML	40.11a	0.07	42.40a	0.27	38.63a	0.52	22.11a	0.39	17.80a	0.00	29.57a	0.39	20.11a	0.28	30.10±10.32a	0.28	7376
OBDT, FA-	20.63b	71.47	11.00b	83.12	9.11c	82.45	9.89bc	82.37	2.97bc	86.54	1.69c	66.10	0.49c	70.59	7.97±7.01b	78.12	1952
OBDT, FA-	18.77b	74.73	8.20bc	79.09	14.26b	79.56	14.17b	83.06	4.89d	77.78	1.74c	57.38	2.86b	81.00	9.27±6.55b	78.20	2271
CC, FA-2	2.06c	76.39	3.63c	80.31	8.54c	76.59	4.37d	83.01	0.26d	66.67	0.49d	82.35	0.49c	82.35	2.83±2.99d	78.82	694
CC, FA-3	16.51b	73.88	4.29c	66.67	6.03cd	75.36	3.17d	79.28	0.66d	65.22	1.26c	63.64	0.49c	76.47	4.63±5.62c	73.19	1134
Tephri,	2.09c	82.19	2.06c	80.56	3.49d	77.87	3.66d	82.81	2.00c	87.14	0.26d	77.78	2.89b	84.16	2.35±1.51d	82.09	575
Frutect	4.71c	60.61	3.91c	80.29	4.46d	81.41	7.34c	79.77	1.43c	72.00	4.09b	76.92	0.83c	96.55	3.82±2.01cd	76.41	937

*the data with the same letter in each column have no significant differences (Duncan's multiple range test, P=0.05)

Tables III and IV show the total number of wild medfly captured, the F/T/D and the percentage of the female medflies captured for each week of the study. The last 5 columns show the total numbers of males and females captured, the average F/T/D and % females captured.

The best wild medfly captures were found in the IPMT, FA-3, dry with 23.18 F/T/D, the Tephri, FA-3, dry with 20.49 F/T/D and the IPMT, FA-3, wet with 19.24 F/T/D (Table III). The best recapture of sterile males was found in the Tephri, FA-3, dry with 32.15 F/T/D (Table IV).

In the natural wild medfly population the lowest percentage of females captured was 61.26% in the OBDT, FA-3, and in four trap types the percentage was greater than 70%.

On the other hand, in the area with sterile released males, the percentage of females captured was between 11.82% to 18.41%.

In all cases, the dry traps were more effective than the wet traps (Tables III and IV).

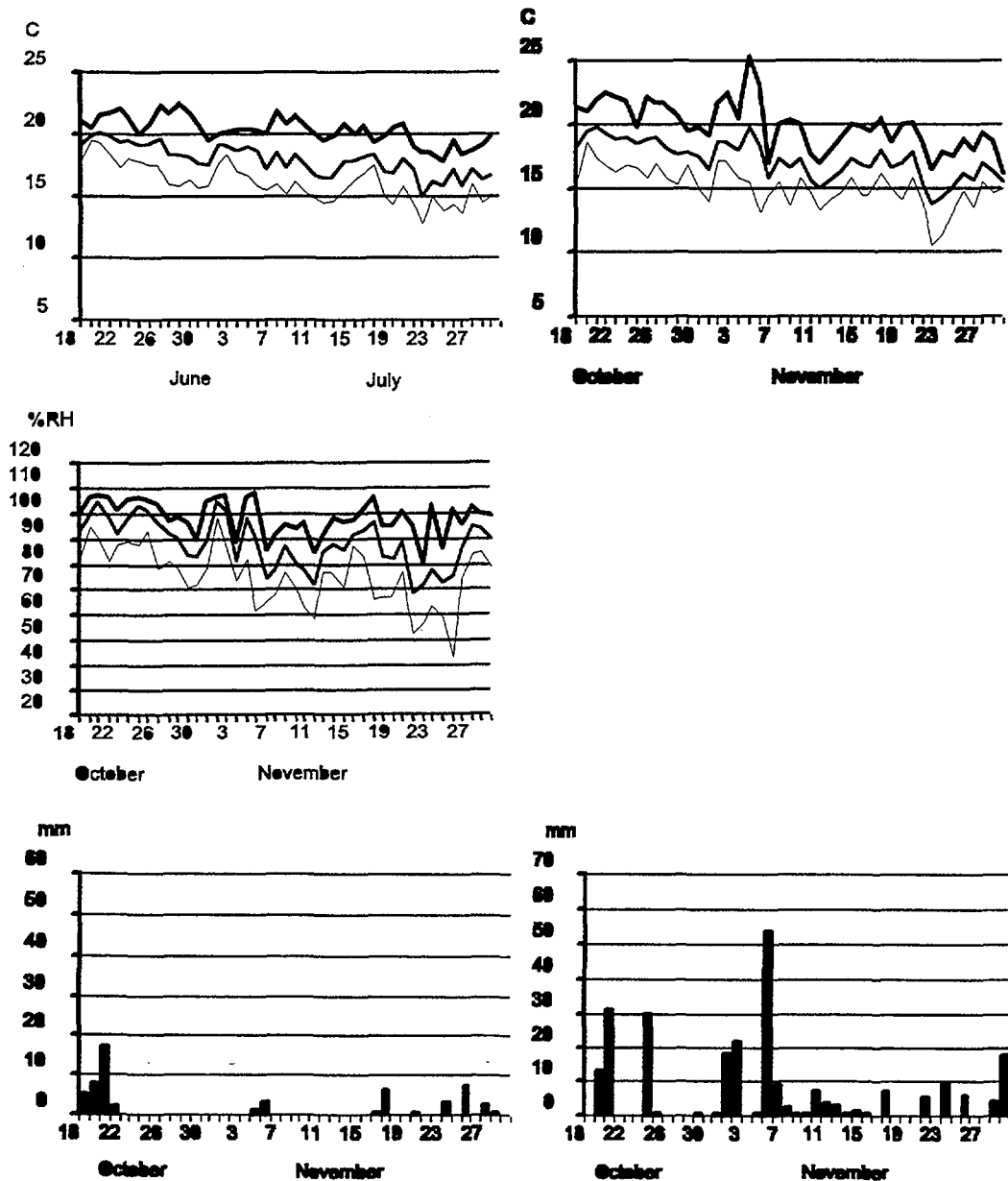


Fig. 4. Climate data during the third study (18 October-30 November, 1997): left column - Experiment 1, Quebradas 80m; right column - Experiment 2, Camacha, 700m; top - daily temperature (maximum, mean and minimum); middle - relative humidity (maximum, mean and minimum); bottom - rainfall.

TABLE III-CAPTURE OF ADULT MEDFLIES IN F/T/D, PERCENT FEMALES AND TOTAL FLIES, AT QUEBRADAS, WITH A WILD MEDFLY POPULATION FROM 24 MAY - 05 JULY, 1997

Trap	Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Totals				
	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	Flies	F/T/D	%		
IPMT, NU+B	2.74c	96.87	2.11b	98.65	2.97d	76.92	1.86d	64.08	2.34d	68.29	2.80d	73.47	104	415	519	2.47±0.44c	79.96
OBDT, FA-3	2.37c	84.34	5.43b	71.58	2.43d	74.12	4.17dc	45.21	5.46c	56.54	1.20d	59.52	296	468	764	3.51±1.77c	61.26
Tephri, FA-3, wet	9.91b	89.05	5.17b	86.19	14.66c	58.28	15.63bc	59.41	5.43c	55.26	4.23c	63.51	638	1288	1926	9.17±5.04b	66.87
Tephri, FA-3, dry	19.60a	88.63	23.66a	92.15	37.71a	70.98	20.74c	54.75	10.60b	61.46	10.66a	63.00	1136	3169	4305	20.50±10.02a	73.61
IPMT, FA-3, wet	20.74a	82.64	20.03a	87.30	18.71bc	64.58	25.20b	66.10	21.83a	62.04	8.91b	68.27	1135	2911	4046	19.24±5.52a	71.95
IPMT, FA-3, dry	27.17a	88.96	22.46a	85.50	21.34b	69.72	37.14a	59.46	16.46a	62.85	14.49a	66.17	1443	3686	5129	23.18±8.19a	71.87

*the data with the same letter in each column have no significant differences (Duncan's multiple range test, P=0,05)

TABLE IV. CAPTURE OF ADULT MEDFLIES IN F/T/D, PERCENT FEMALES AND TOTAL FLIES AT RIBEIRA BRAVA WITH GROUND STERILE MALES RELEASES FROM 24 MAY-05 JULY, 1997

Trap	Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Totals				
	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	Flies	F/T/D	%		
IPMT, NU+B	2.14d	8.00	9.29d	13.23	3.05d	54.21	1.11d	28.20	0.94c	54.55	8.91d	8.97	727	164	891	4.24±3.84d	18.41
OBDT, FA-3	18.29c	23.75	38.54b	5.63	13.71c	14.32	5.46c	19.61	3.57b	34.40	16.86c	4.58	2858	383	3241	16.07±12.53c	11.82
Tephri, FA-3, wet	19.26c	21.21	31.69c	4.24	8.09c	17.31	7.89c	19.93	4.89b	44.44	17.57c	15.61	2662	466	3128	14.94±10.13c	14.90
Tephri, FA-3, dry	55.49a	12.36	42.40a	7.14	22.37a	15.84	23.54a	21.18	11.75a	39.21	37.34a	9.72	5660	844	6504	32.15±15.89a	12.98
IPMT, FA-3, wet	11.43b	14.75	25.49a	11.55	22.50c	22.38	7.50c	20.95	5.36b	36.67	15.39c	13.23	2254	459	2713	14.61±8.09c	16.92
IPMT, FA-3, dry	41.43b	11.51	44.79a	8.05	21.31b	28.82	12.71b	40.45	3.25b	43.96	24.46b	10.51	3878	775	4653	24.66±16.12b	16.98

*the data with the same letter in each column have no significant differences (Duncan's multiple range test. P=0.05)

TABLE V. CATCH OF ADULT MEDFLIES IN F/T/D, PERCENT FEMALES AND TOTAL FLIES AT CAMACHA (700 M) FROM 18 OCTOBER - 29 NOVEMBER, 1997

Trap	Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Totals				
	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	Flies	F/T/D	%		
IPMT, NU+B	0.29c	50.00	0.06c	50.00	0.14b	60.00	0.14c	60.00	0.00e	-	0.08d	100.00	10	14	24	0.12±0.10e	58.33
OBDT, FA-3	0.77b	85.19	1.34a	40.43	1.20a	54.76	1.06a	56.76	1.06a	51.35	0.37c	61.54	90	113	203	0.97±0.35b	55.67
Tephri, FA-3, wet	0.80b	82.14	0.40b	64.29	0.11b	50.00	0.29b	50.00	0.06d	50.00	0.09d	0.00	21	40	61	0.29±0.28d	65.57
Tephri, FA-3, dry	3.91a	72.26	1.43a	64.00	0.29b	62.50	0.50a	50.00	0.21bc	16.67	1.04b	65.52	81	163	244	1.23±1.39a	66.80
IPMT, FA-3, wet	0.14c	100.00	0.39b	63.63	0.00c	-	0.10c	100.00	0.14c	0.00	1.19b	60.00	17	28	45	0.33±0.44d	62.22
IPMT, FA-3, dry	0.64b	72.22	0.32b	77.78	0.00c	-	0.29b	50.00	0.68b	31.58	1.46a	53.66	43	52	95	0.57±0.50c	54.74

*the data with the same letter in each column have no significant differences (Duncan's multiple range test. P=0.05)

TABLE VI. CATCH OF ADULT MEDFLIES IN F/T/D, PERCENT FEMALES AND TOTAL FLIES AT QUEBRADAS (80 M) FROM 18 OCTOBER - 29 NOVEMBER, 1997

Trap	Week 1		Week 2		Week 3		Week 4		Week 5		Week 6		Totals				
	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	F/T/D	%	Flies	F/T/D	%		
IPMT, NU+B	0.26d	44.44	0.51e	66.67	0.37d	38.46	0.71e	64.00	0.74f	73.08	0.03d	100.00	35	57	92	0.44±0.27d	61.96
OBDT, FA-3	2.46c	56.47	3.17d	50.45	1.74c	45.90	1.74d	72.13	2.26e	68.35	1.09c	52.63	185	250	435	2.08±2.72c	57.47
Tephri, FA-3, wet	2.17c	64.47	5.54c	67.53	2.06c	47.22	2.46d	70.93	5.74d	43.28	1.66c	41.38	301	386	687	3.27±1.85c	56.19
Tephri, FA-3, dry	4.17b	59.59	8.86b	68.71	7.17ab	53.78	7.34a	66.15	8.37c	68.94	1.66c	50.00	479	836	1315	6.26±2.78b	63.57
IPMT, FA-3, wet	8.74a	64.38	11.34a	72.29	5.74b	55.72	4.89c	64.33	5.40d	60.32	2.80b	46.94	496	866	1362	6.49±3.05b	63.58
IPMT, FA-3, dry	7.63a	65.17	12.03a	62.00	9.03a	60.76	6.14ab	62.79	21.89a	51.83	5.77a	60.89	905	1282	2187	10.42±6.06a	58.62

*the data with the same letter in each column have no significant differences (Duncan's multiple range test. P=0.05)

3.3. Study Three - 1997

Fig. 4 shows temperature (maximum, mean and minimum), relative humidity (maximum, mean and minimum) and rainfall data for the two areas (Quebradas and Camacha).

During the study at 80 meters above sea level (Study 1), the minimum temperature fluctuated between 13 - 19 °C, decreasing as the study progressed. The maximum daily temperatures ranged from 18 - 22 °C with an average of 20.26 ± 1.14 °C. The relative humidity was high during nearly all of the test period. Rain occurred only on 17 days, with a total of 56.8mm.

During the study at 700m (Study 2), temperatures during the first three weeks were similar to the first study, but were lower during the last three weeks. Rain occurred on 30 days, with a total of 248.2mm. There was no RH data available.

Tables V and VI show the F/T/D and the percentage of the female medflies captured. The last five columns show the total numbers of males and females and the average F/T/D and % females captured.

At high elevations (700 m) the Tephri, FA-3, dry captured the most flies with 1.23 F/T/D (Table V). At the low elevations (80 m) the IPMT, FA-3, dry captured 10.41 F/T/D (Table VI).

In both studies the percentage of females captured ranged between 55.67% to 65.57%. Again, dry traps were more effective than the wet traps at capturing wild flies.

4. CONCLUSIONS

4.1. First study

The most effective female medfly attractant during both 7 week periods were the FA-3 attractants - a combination of ammonium acetate, putrescine and trimethylamine (FA-3).

Trimedlure (TML) baited traps captured essentially no females, although they captured more flies than the other 6 traps combined.

FA-3 baited traps removed about 90 times more female medflies from the population than TML baited traps.

The addition of trimethylamine to ammonium acetate plus putrescine increased total fly capture but had no impact on % females captured.

FA-3 baited traps have potential as a survey tool for female medflies. Additional data are needed to determine the effect of cool temperatures on trapping effectiveness of FA-3.

4.2. Second study

The best traps in natural wild medfly populations were: IPMT, FA-3, dry; Tephri, FA-3, dry; and IPMT, FA-3, wet with an average F/D/T of 20.97 ± 2.01 .

The best trap in areas with sterile males was the Tephri, FA-3, dry with 32.15 F/T/D.

In areas with only wild medfly populations, the lowest percentage of females captured was 61.26% in the OBDT, FA-3. In 4 trap types, this percentage was above 70%.

In areas with sterile males, the percentage of females captured was between 11.82% to 18.41%.

Dry traps were more effective than the wet traps.

4.3. Third study

At high elevations (700m) the best trap was the Tephri, FA-3, dry with 1.23 F/T/D.

At low elevations (80m) the best trap was the IPMT, FA-3, dry with 10.41 F/T/D.

At both elevations, the percentage of female medflies captures was between 55.67% to 65.57%, similar to results from Study 2.

Dry traps were more effective than the wet traps as in Study 2.

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REFERENCES

- [1] HENDRICHS, J., et al., Increased effectiveness and applicability of the sterile insect technique through male-only releases for control of Mediterranean fruit flies during fruit seasons, *J. Appl. Entomol.* **119** (1995) 371-377.
 - [2] EPSKY, N.D., et al., Visual cue and chemical cue interactions in a dry trap with food-based synthetic attractant for *Ceratitidis capitata* and *Anastrepha ludens* (Diptera: Tephritidae), *Environ. Entomol.* **24** (1995) 1387-1395.
 - [3] PEREIRA, R., CARVALHO, J.P., "Trap utilization on study of Mediterranean fruit fly populations at citrus groves in Portugal", In: *Fruit fly pests, a world assessment of their biology and management* (McPheron & Steck Ed.) (1996) 135-140.
 - [4] HEATH, R.R., et al., Systems to monitor and suppress *Ceratitidis capitata* (Diptera: Tephritidae) populations, *Florida Entomol.* **79** (1996) 144-153.
 - [5] HEATH, R.R., et al., Development of a dry plastic insect trap with food-based synthetic attractant for Mediterranean and Mexican fruit flies (Diptera: Tephritidae), *J. Econ. Entomol.*, **88** (1995) 1307-1315.
 - [6] MONTGOMERY, D.C., *Design and analysis of experiments*, Wiley & Sons Ed., New York (1991)
 - [7] EPSKY, N.D., et al., Field evaluation of female-targeted trapping systems for *Ceratitidis capitata* (Diptera: Tephritidae) in seven countries (in press).
 - [8] ROS, J.P., et al., Ensayos de campo con un nuevo atrayente de hembras de la mosca mediterránea de la fruta *Ceratitidis capitata* Wied. (Diptera: Tephritidae), *Bol. San. Veg. Plagas* **22** (1996) 151-157.
 - [9] ROS, J.P., et al., La trimetilamina: un efectivo potenciador de los atrayentes putrescina y acetato de amonio para capturar las hembras de la mosca mediterránea de la fruta *Ceratitidis capitata* Wied. (Diptera: Tephritidae), *Bol. San. Veg. Plagas* **23** (1997): 515-521.
- PEREIRA, R., et al., Area-wide control of the Mediterranean fruit fly on Madeira with Sterile Insect Technique, *Proc. Int. Soc. Citriculture* (1997) 568-572.

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