MEDFLY FEMALE ATTRACTANT TRAPPING STUDIES IN GUATEMALA

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Abstract

Experiments were conducted from 1994 - 1998 to test the attractiveness of combinations of food-based chemicals for *C. capitata* (medfly) in Guatemala. Most studies were done in coffee. The 1995 studies, using the FA-2 attractants (ammonium acetate and putrescine) showed that this combination was attractive for females and had potential for use in conjunction with a SIT program. The 1996 studies at three elevations demonstrated that, in general, these attractants, when used in either the Open Bottom Dry Trap (OBDT), Closed Bottom Dry Trap(CBDT), or International Pheromone's McPhail Trap (IPMT) performed better than the Jumbo McPhail trap(JMT) baited with NuLure and borax (NU+B) for capture of feral females. At the high elevation (1400 m), the IPMT with FA-2 and OBDT with FA-2 were best; at the middle elevation (1100 m), the OBDT, IPMT, and CBDT with FA-2 were best; and at low elevations (659 m), the IPMT with FA-2, JMT with NU+B and OBDT with FA-2 were equal in performance. At the middle elevation, using sterile flies, the OBDT with FA-2 worked best. When experiments were carried out in pear, the traps using the FA-2 attractants captured more female flies than the JMT, NU+B, but not significantly more. During the 1997 trials, a third component, trimethylamine was added to the two component lure (FA-3). This attractant was tested in a number of locally produced traps using 2 l soft drink bottles with different color bottoms. The dry versions of the traps contained a yellow sticky insert. All study sites were at low elevation 600 - 650 m, in coffee, testing both sterile and feral flies. With the feral flies during the first phase of the study at finca San Carlos, there were no significant differences between treatments, at finca San Luis, the clear local trap with sticky insert and the green local trap with sticky insert were best, and at finca Valapraiso, the green local trap with yellow sticky insert and yellow local trap with sticky insert captured more flies. During the second phase of the study, only finca Valparaiso reported significant differences. Here the IPMT, FA-3 with sticky insert and the clear local trap with sticky insert worked best. For sterile flies, the Jackson trap with Trimedlure (JT, TML) and a locally made OBDT, FA-3 with yellow sticky insert were best at finca San Carlos, the JT, TML and the yellow local trap with sticky insert were best at finca San Luis and the JT, TML and the green local trap with yellow sticky inset captured most flies at finca Valparaiso. For some unexplained reason, all wet versions of the traps performed poorly. In pear, the Tephri, FA-3, wet performed best, followed by the wet, yellow local traps without and with the yellow sticky insert, respectively. Trials were also conducted to construct egging devices for sterility assessment. Females did lay eggs into various artificial substrates. However, both mated and unmated feral females laid eggs into agar balls, so, unless mating events are recorded, per cent egg hatch and number of eggs produced per female.

1. INTRODUCTION

This document summarizes work carried out as part of the five year Co-ordinated Research Programme (CRP) on trapping *Ceratitis capitata* Wied. (medfly) sponsored by the IAEA/FAO Joint division. Programme priorities were to develop female attractants for medfly and to evaluate the efficacy of female attractants under field conditions. In addition to the work described by protocol, cooperators were asked to review the following work areas: evaluation of several new trap types; evaluate performance of female attractants in areas subjected to release of sterile insects; and evaluate female attractants in combination with different trap types for the purpose of retaining female medflies for oviposition and thus assess sterility induced in the feral population.

During the first phase of the program (1994), a recently developed trap and female attractant [1], consisting of a combination of ammonium acetate (AA) and putrescine (P), the FA-2 attractants, in a Closed bottom dry trap (CBDT) were tested against the standard male attractant, Trimedlure placed in a Jackson Trap (JT). Testing was conducted at three elevations in the coffee belt of Guatemala.

The 1995/96 studies concentrated on evaluating female attractants in combination with three different trap types - the CBDT, FA-2, an Open bottom dry trap (OBDT) baited with FA-2, the International Pheromone's McPhail Trap (IPMT) with FA-2, and compared these to the JT, TML and a jumbo plastic McPhail trap (JMT) baited with NuLure and borax (NU+B). As previously, evaluations were carried out at three elevations in coffee. Additionally, a trial was conducted in pears.

Further work [1] demonstrated that the addition of trimethylamine (TMA) to the FA-2 attractants (FA-3 attractants) improved the efficacy of the new female lures and this was tested in the various traps. At the second CRP co-ordination meeting, it was discussed that trapping efficiency in various countries was related to finding a suitable trap for each unique situation and cooperators were asked to develop a local trap for use with the FA-3 attractants, and to test the lures in a Spanish modification of the IPMT, the Tephri trap. In Guatemala, we also tested a biodegradable OBDT for use with the lures.

The 1997/98 studies were again conducted at three altitudes in coffee and in a deciduous area. Additional work was performed to determine the efficacy of the FA-3 attractants in wet and dry versions of the IPMT and Tephri traps. Wet traps generally contained water and surfactant, while dry traps contained a plug of DDVP for fly retention. We also developed three local traps and tested these both as wet and dry traps using the FA-3 attractants.

Finally, we tested synthetic lures for detecting the first generation of feral insects in the field. Guatemala will soon be implementing the use of a male only strain in medfly sterile release programs.

Additional experiments were undertaken to devise artificial ovipositional substrates. These substrates were tested in the field, the laboratory and in field cages using sterile and feral flies.

2. 1994 STUDIES

2.1. 1994 materials and methods

Trap evaluation was carried out during the 24th to 47th week (the week of 12 June through 26 November). Traps were evaluated at three different elevations and at four farms (fincas): Mujulia and Culpan (high elevation, 1400 m), El Transito (middle elevation, 1050 m) and Las Delicas (low elevation, 659 m). These sites were in the coffee area of Coatepeque (Dept. of Quetzaltenango) located 240 km southwest of Guatemala city. At all sites, the host was coffee.

Two traps were compared. The CBDT trap consisted of a light green acetate sheet with a color band 12 cm wide. There were holes for insect entry. The acetate sheet was rolled so that a hollow tube was formed and petri dish halves were placed at either end. There was a wire to hang the trap in a tree. For attractants, separate patches of AA+P were attached to the inner sides of the trap. Toxicant squares were used as a killing agent. The other trap tested was the JT, TML and was handled based on a standard MOSCAMED protocol. For the CBDT, re-baiting was done every eight weeks and for the JT, TML, every four weeks.

Statistical analysis was done with analysis of variance (ANOVA) and a pairwise comparison of means (Tukey's test, 95% confidence).

2.2. 1994 results

Results from the 1994 studies are shown in Tables I - IV.

TABLE I. MEDFLY CAPTURES BY CBDT, FA-2 VS. JT, TML AT FINCA MUJULIA, COLOMBA, QUETZALTENANGO - ELEVATION 1400 M

Week of	CBDT, FA-2			JT, TML	
the year	males	females	Total	males	Total
24	104	137	241	436	436
25	68	109	177	336	336
26	14	15	29	144	144
27	32	113	145	158	158
28	29	61	90	120	120
29	48	106	154	193	193
30	70	114	184	212	212
31	151	201	352	309	309
32	175	257	432	125	125
33	108	159	267	103	103
34	119	163	282	277	277
35	65	88	153	615	615
36	77	82	159	430	430
37	49	71	120	561	561
38	9	23	32	236	236
39	7	18	25	83	83
40	16	25	41	35	35
41	23	58	81	56	56
42	15	35	50	21	21
43	15	18	33	37	37
44	40	34	74	64	64
45	15	15	30	54	54
46	7	5	12	59	59
47	9	4	13	33	33

TABLE II. MEDFLY CAPTURES BY CBDT, FA-2 VS. JT, TML AT FINCA CULPAN, COLOMBA, QUETZALTENANGO - ELEVATION 1400 M

Week of	CBDT, FA-2			JT, TML	
the year	males	females	Total	males	Total
24	6	2	8	59	59
25	0	0	0	34	34
26	3	3	6	31	31
27	1	2	3	14	14
28	0	3	3	15	15
29	1	0	1	23	23
30	1	4	5	10	10
31	2	4	6	24	24
32	4	1	5	5	5
33	6	6	12	9	9
34	4	0	4	13	13
35	1	0	1	25	25
36	0	0	0	7	7
37	0	0	0	22	22
38	3	4	7	21	21
39	0	0	0	12	12
40	2	1	3	8	8
41	6	9	15	25	25
42	14	17	31	18	18
43	14	15	29	19	19
44	2	2	4	13	13
45	3	2	5	13	13
46	0	0	0	13	13
47	2	1	3	25	25

TABLE III. MEDFLY CAPTURES BY CBDT, FA-2 VS. JT, TML AT FINCA EL TRANSITO, COLOMBA, QUETZALTENANGO - ELEVATION 1050 M

Week of the year	CBDT, FA-2 males	CBDT, FA-2 females	CBDT, FA-2 Total	JT, TML males	JT, TML Total
24	1	3	4	29	29
25	0	3	3	43	43
26	0	1	1	21	21
27	2	3	5	27	27
28	9	14	23	55	55
29	3	7	10	74	74
30	9	13	22	172	172
31	8	15	23	190	190
32	9	6	15	187	187
33	10	16	26	147	147
34	0	0	0	224	224
35	8	18	26	495	495
36	1	0	1	334	334
37	1	6	7	71	71
38	6	9	15	40	40
39	5	5	10	28	28
40	2	12	14	53	53
41	4	8	12	48	48
42	6	10	16	39	39
43	7	9	16	57	57
44	1	2	3	15	15
45	0	0	0	7	7
46	0	0	0	9	9
47	0	0	0	29	29

TABLE IV. MEDFLY CAPTURES BY CBDT, FA-2 VS. JT, TML AT FINCA LAS DELICIAS, COLOMBA, QUETZALTENANGO - ELEVATION 659 M

Week of the year	CBDT, FA-2 males	CBDT, FA-2 females	CBDT, FA-2 Total	JT, TML males	JT, TML Total
24	0	0	0	52	52
25	1	0	1	55	55
26	0	1	1	22	22
27	0	0	0	21	21
28	0	0	0	9	9
29	0	0	0	22	22
30	0	0	0	13	13
31	0	4	4	25	25
32	0	0	0	35	35
33	3	3	6	40	40
34	0	0	0	50	50
35	0	0	0	28	28
36	0	0	0	15	15
37	0	1	1	23	23
38	4	1	5	43	43
39	2	0	2	20	20
40	1	1	2	19	19
41	2	2	4	37	37
42	2	1	3	16	16
43	0	0	0	14	14
44	1	0	1	6	6
45	0	0	0	13	13
46	1	0	1	27	27
47	0	0	0	19	19

2.3. 1994 study - discussion and conclusions

Results reported here are an outcome of the evaluation of the traps provided (JT, TML and CBDT, FA-2). These traps were assessed at different elevations and different abiotic regimes and fly populations. The analysis of the results shows that, attractants and assessed traps may give a different response according to the abiotic conditions and the population level in the surrounding areas. It has been shown that, in high population conditions, the dry trap used as a monitoring device could be similar to current monitoring systems, based on the use of Jackson traps. No significant differences were observed when dry traps were located at 1400 m and with relatively large fly populations. A different result was observed at the same altitude but with a relatively lower population. In all other localities, total capture of insects was significantly lower possibly because of the population level or as an effect of environmental conditions.

It can be concluded that with the exception of the test conducted at high altitude and under a high population level (in which calibrations would have to be made, the dry trap is giving a different profile of the population and is probably not at this time the correct device for monitoring populations, at least not in the traditional sense.

3. 1995 STUDIES

3.1. 1995 materials and methods

Studies in 1995 were conducted from the week of 19 February through the week of June 18 at three elevations in southwest Guatemala near the Mexican border. Listed from high to low elevation, the fincas were: Culpan (1400 m); El Transito (1100 m) and Las Delicias (659 m). At each finca, a trapping grid of 20 traps was installed. Four lines of five traps each were necessary. The distance between the lines was 50 m and distance between traps along the lines was 40 m. Traps were rotated along the lines at each check period. Trap servicing was conducted on a weekly basis. Re-baiting of traps was conducted as follows: JT, TML, every two weeks; OBDT, FA-2, every four weeks. Weekly servicing of traps included the following: total sterile insect captures in each trap; male and female sterile insect captures in each trap; and total feral flies captured in each trap type. Twelve release points were defined in the trapping grid. Releases of sterile insects were conducted by ground on a weekly basis. Sterile insect density for this study was 3000 adult insects per hectare. The standard strain was utilized in this test (both sexes). Insects were released from paper bags as done by the local action program. An OBDT, FA-2 was tested against the JT, TML.

3.2. 1995 results, discussion, and conclusions

Results from these experiments have been presented elsewhere and are summarized here. It was evident that the JT, TML always captured a higher number of sterile flies at the three elevations when compared to the OBDT, FA-2 trap. Insect identification at the MOSCAMED headquarters in the area clearly demonstrated that the JT, TML required much more time than the dry trap (6 times more) for processing of insect recapture. A close analysis of the collected data is telling us the following: 1) at the low elevation the JT, TML captured an average of 16.6 times more males than the dry trap, while the OBDT, FA-2 captured an average of 358.35 times more females than the JT, TML;2) at the middle elevation, the JT, TML captured 29.55 times more males than the dry trap, while the OBDT, FA-2 captured 996.33 times more females than the JT, TML; and 3) at the high elevation, the JT, TML captured 9.54 times more males than the OBDT, FA-2, while the OBDT, FA-2 captured an average of 1,227 times more

females than the JT, TML. Based on the available information, it is clear that the use of the OBDT, FA-2 would favor the Sterile Insect Technique (SIT) by keeping the males in the target area and also by removing the sterile females from the target population and increasing the probability of more desirable encounters between the sterile males and the wild females.

4. 1996 STUDIES

4.1. 1996 materials and methods - coffee

During 1996, two sets of experiments were conducted. The traps used were: JT, TML; CBDT, FA-2; an Open bottom dry trap (OBDT) also baited with FA-2; IPMT with FA-2 attractants and containing a solution of colored water; and plastic Jumbo McPhail traps baited with NU+B (JMT, NU+B).

Study I evaluated the combination of attractants/trapping devices at three elevations: 1400 m (Finca Mujulia); 1100 m (Finca San Francisco); and 659 m (Finca Las Delicias). Study I was carried out at the end of coffee harvesting season (from the week of February 25 through the week of April 21). At these sites, this time of year is normally dry but some off-season rains occurred. The host availability in the area was low, but the host suitability was adequate for fruit fly population establishment at all work sites. Traps were hung 2 m above the ground. The field array was a grid in which traps were 25 m apart within lines and 50 m between lines. At Finca Mujulia and Finca Delicias, test were conducted with feral flies. At Finca San Francisco, the parallel study included weekly releases of sterile flies (both sexes) and fruit fly parasitoids. This was taken into consideration and assessed traps were also included in this block.

4.2. 1996 results - coffee

Results from the 1996 studies are shown in Tables V - XVI.

TABLE V. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE (HSD) TEST OF MALE CAPTURE AT FINCA MUJULIA, 1996 -ELEVATION 1400 M

GROUPINGS*	MEAN	N	TRAP TYPE
A	36.056	9	JT, TML
A B	26.667	9	IPMT, FA-2
A B C	24.333	9	OBDT, FA-2
B C	16.667	9	CBDT, FA-2
C	11.278	9	JMT, NU + B

Alpha= 0.05, df= 40, MSE= 107.294, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 13.947; * Means with the same letter are not significantly different

TABLE VI. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE (HSD) TEST OF FEMALE CAPTURE AT FINCA MUJULIA, 1996 -ELEVATION 1400 M

GROUPINGS*	MEAN	N	TRAP TYPE
A	34.722	9	IPMT, FA-2
A B	33.000	9	OBDT, FA-2
B C	23.278	9	JMT, NU + B
C	17.778	9	CBDT, FA-2
D	6.222	9	JT, TML

Alpha= 0.05, df= 40, MSE= 64.706, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 10.831; * Means with the same letter are not significantly different

TABLE VII. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE (HSD) TEST OF TOTAL CAPTURE (MALES & FEMALES) AT FINCA MUJULIA, 1996 - ELEVATION 1400 M

GROUPINGS*	MEAN	N	TRAP TYPE
A	32.111	9	IPMT, FA-2
A B	29.111	9	OBDT, FA-2
A B C	25.167	9	JT, TML
B C	15.167	9	JMT, NU + B
C	13.444	9	CBDT, FA-2

Alpha= 0.05, df= 40, MSE= 127.162, Critical Value of Studentized Range= 4.0, Minimum Significant Difference= 15.183; * Means with the same letter are not significantly different

TABLE VIII. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE (HSD) TEST FOR MALE CAPTURE AT FINCA SAN FRANCISCO, 1996 - ELEVATION 1100 M

GROUPINGS*	MEAN	N	TRAP TYPE
A	37.556	9	JT, TML
B	24.778	9	OBDT, FA-2
B	20.500	9	IPMT, FA-2
B	19.167	9	CBDT, FA-2
B	13.000	9	JMT, NU+B

Alpha= 0.05, df= 40, MSE= 80.469, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 12.078; * Means with the same letter are not significantly different

TABLE IX. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE (HSD) TEST FOR FEMALE CAPTURE AT FINCA SAN FRANCISCO,1996 - ELEVATION 1100 M

GROUPINGS*	MEAN	N	TRAP TYPE
A	30.833	9	OBDT, FA-2
A B	30.000	9	IPMT, FA-2
A B C	23.222	9	CBDT, FA-2
B C	16.500	9	JMT, NU+B
C	14.444	9	JT, TML

Alpha= 0.05, df= 40, MSE= 111.9319, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 14.245; * Means with the same letter are not significantly different

TABLE X. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE (HSD) TEST FOR TOTAL CAPTURE (MALES & FEMALES) AT FINCA SAN FRANCISCO, 1996 - ELEVATION 1100 M

GROUPINGS*	MEAN	N	TRAP TYPE
A	32.056	9	JT, TML
A	27.389	9	OBDT, FA-2
A B	24.944	9	IPMT, FA-2
A B	18.833	9	CBDT, FA-2
B	11.778	9	JMT, NU+B

Alpha= 0.05, df= 40, MSE= 125.097, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 15.059; * Means with the same letter are not significantly different

TABLE XI. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE (HSD) TEST FOR MALE CAPTURE AT FINCA SAN FRANCISCO, 1996 - ELEVATION 1100 M (STERILE FLIES)

GROUPINGS*	MEAN	N	TRAP TYPE
A	41.000	9	JT, TML
B	29.444	9	OBDT, FA-2
C	20.833	9	CBDT, FA-2
C	16.667	9	IPMT, FA-2
D	7.056	9	JMT, NU+B

Alpha= 0.05, df= 40, MSE= 39.873, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 8.502; * Means with the same letter are not significantly different

TABLE XII. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE TEST (HSD) OF FEMALE CAPTURE AT FINCA SAN FRANCISCO, 1996 - ELEVATION 1100 M (STERILE FLIES)

GROUPINGS*	MEAN	N	TRAP TYPE
A	38.444	9	OBDT, FA-2
B	28.167	9	CBDT, FA-2
B	26.833	9	IPMT, FA-2
C	14.611	9	JMT, NU+B
C	6.944	9	JT, TML

Alpha= 0.05, df= 40, MSE= 52.721,Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 9.7763; * Means with the same letter are not significantly different

TABLE XIII. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE TEST (HSD) OF TOTAL CAPTURE (MALES & FEMALES) AT FINCA SAN FRANCISCO, 1996 - ELEVATION 1100 M (STERILE FLIES)

GROUPINGS*	MEAN	N	TRAP TYPE
A	41.000	9	JT, TML
B	29.389	9	OBDT, FA-2
C	19.833	9	CBDT, FA-2
C	17.667	9	IPMT, FA-2
D	7.111	9	JMT, NU+B

Alpha= 0.05, df= 40, MSE= 42.169, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 8.743; * Means with the same letter are not significantly different

TABLE XIV. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE TEST (HSD) OF MALE CAPTURE AT FINCA LAS DELICIAS, 1996 - ELEVATION 659 M

GROUPINGS*	MEAN	N	TRAP TYPE
A	40.111	9	JT, TML
B	23.667	9	IPMT, FA-2
B	22.556	9	OBDT, FA-2
B	21.333	9	JMT, NU+B
C	7.333	9	CBDT, FA-2

Alpha= 0.05, df= 40, MSE= 67.065, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 11.026; * Means with the same letter are not significantly different

TABLE XV. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE TEST (HSD) OF FEMALE CAPTURE AT FINCA LAS DELICIAS, 1996 - ELEVATION 659 M

GROUPINGS*	MEAN	N	TRAP TYPE
A	33.000	9	IPMT, FA-2
A	30.556	9	JMT, NU+B
A	30.111	9	OBDT, FA-2
B	13.222	9	CBDT, FA-2
B	8.111	9	JT, TML

Alpha= 0.05, df= 40, MSE= 67.014, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 11.022; * Means with the same letter are not significantly different

TABLE XVI. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE TEST (HSD) OF TOTAL CAPTURE (MALES & FEMALES) AT FINCA LAS DELICIAS, 1996 - ELEVATION 659 M

GROUPINGS*	MEAN	N	TRAP TYPE
A	37.111	9	JT, TML
A B	25.889	9	IPMT, FA-2
B	22.667	9	JMT, NU+B
B	22.444	9	OBDT, FA-2
C	6.889	9	CBDT, FA-2

Alpha= 0.05, df= 40, MSE= 84.472, Critical Value of Studentized Range= 4.039, Minimum Significant Difference= 12.375; * Means with the same letter are not significantly different

4.3. 1996 discussion and conclusions -coffee

4.3.1. High elevation - Finca Mujulia

Based on the data, it was clear that the fruit fly population was fairly high and larval fruit infestation was moderately high. From results obtained at this elevation (Tables V- VII), it can be stated that FA-2 attractants, when combined with the OBDT and the IPMT performed better than the rest of the traps. Figures on feral female capture in OBDTs were higher when compared to JT, TML total captures (males only). The McPhail trap baited with NU+B had a very poor performance at this elevation. Results suggest that at this elevation it would be better to replace JT, TMLs for traps with female attractants, because, under this test condition, it would provide better monitoring of the feral fly population level.

4.3.2. Middle elevation - Finca San Francisco

From trapping studies with feral flies, the data showed that the fruit fly population was low and the host fruit infestation was also low during the study period. When results of female

captures were compared at this elevation (Tables VIII - X for feral flies and Tables XI - XIII for sterile flies), it was clear that the OBDT, FA-2 and IPMT, FA-2 were the most suitable for this type of capture. When statistical comparison of total capture of flies was carried out, the results of such comparisons were similar to the ones obtained with male capture contrast. Thus, although trapping of females is feasible at this elevation, comparison of population numbers based on captures of the different traps would seem different based on the differences in numbers captured for male or female specific traps. At this elevation, the JT, TML captured the highest number of feral flies when compared to the rest of the traps. The OBDT, FA-2 and the IPMT, FA-2 came second and in the same order as for the high elevation. Here again, the JMT, NU+B did not perform well.

Statistical analysis of trap captures with sterile insects of both sexes at this elevation showed that the JT, TML performed best. This would not be a desirable situation for use with sterile male only strains. When captures of females were compared, the OBDT, FA-2 was the most successful. The next best was the CBDT, FA-2. Comparisons of total captures of sterile insects at this elevation followed the same trend as total captures of feral flies. When data on F/T/D for sterile insects were compared, the JT, TML captured 12.5 more flies than the OBDT, FA-2. Previous studies in the same area showed similar results (Jerónimo, unpublished data). This is a factor that should be considered when planning and/or conducting trapping activities in areas under sterile insect release. Conversely, data analysis for sterile female captures under the same circumstances showed that, 22.8, 10.9, 9.0, and 2.88 times more captures for the OBDT, FA-2, the CBDT, FA-2, IPMT, FA-2 JMT, and NU+B. respectively compared to JT, TML. This situation may be desirable when releasing a bisexual strain due to competition for males and, in highly developed agriculture, sterile females attempt oviposition, causing damage to the fruit. Thus, their removal would be beneficial.

4.3.3. Low elevation - Finca Las Delicias

Results have been shown in Tables XIV - XVI. At this elevation, the adult insect populations and larval infestation rates were high. Comparisons of weekly temperatures showed significantly higher temperatures than the other sites. Female capture comparisons showed that traps containing liquids (IPMT, FA-2 and JMT, NU+B) were most suitable for feral population detection. This may be associated with the climatic conditions prevailing in the area. Based on total insect captures, the JT, TML performed best. The FA-2 attractants combined with the IPMT gave the best results but captures in the JMT, NU+B very similar. This was a different result than at the other two sites. This may be an important consideration since, as stated by Ripley (1940) and cited by [2], insects subject to climatic stress tend to search for water even over long distances.

4.4. 1996 materials and methods - deciduous area

Another study, with the same type of traps, was carried out in a deciduous area in Antigua (ca 45 km from Guatemala City) at an altitude of 2100 m. Study II was carried out during May and June1996 in pear. The fruit fly population was low and host availability was low. There were not adequate hosts for fruit fly population build-up. The native pears and peaches had undergone harvesting, and Tennessee pears were very green. The field distribution of traps was similar to Study I.

Jackson traps were re-baited every two weeks. CBDT and OBDT dry traps were re-baited every four weeks. IPMTs with FA-2 and colored water were refilled every week and lures were replaced after four weeks, and IPMTs with NU+B were re-baited every week.

Weekly data collection was carried out, and information gathered included: total insect capture in each trap, fertile and sterile insect captures, captures by sex, host fruit larval infestation, host availability, host suitability and weather parameters.

Statistical analysis carried out consisted in assigning an increasing unitary value (rank) to each of the fly/trap/day (F/T/D) figures for each of the traps (in an increasing order). Analysis of variance was performed on the assigned ranks for each of the figures. This procedure is an approximation of the non-parametric Kruskall-Wallis test [3]. Multiple comparison of means (Tukey's HSD test) followed by ANOVA was carried out. Statistical Analytical System, SAS, was used to perform the calculations [4].

4.5. 1996 results - deciduous area

Results from this study are shown in Tables XVII - XXII.

TABLE XVII. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE TEST (HSD) OF MALE CAPTURE AT THE DECIDUOUS AREA (FINCA DUEÑAS), 1996

GROUPINGS	MEAN	N	TRAP TYPE
A	26.000	8	JT, TML
A	22.875	8	OBDT, FA-2
A	21.000	8	IPMT, FA-2
A	18.437	8	CBDT, FA-2
A	14.188	8	JMT, NU+B

Alpha= 0.05, df= 35, MSE= 119.159, Critical Value of Studentized Range= 4.066, Minimum Significant Difference= 15.692; * Means with the same letter are not significantly different.

TABLE XVIII. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE TEST (HSD) OF FEMALE CAPTURE AT THE DECIDUOUS AREA (FINCA DUEÑAS), 1996

GROUPINGS	MEAN	N	TRAP TYPE
A	28.500	8	IPMT, FA-2
A	23.625	8	OBDT, FA-2
A	22.000	8	CBDT, FA-2
A	21.375	8	JMT, NU+B
B	7.000	8	JT, TML

Alpha= 0.05, df= 35, MSE= 87.236, Critical Value of Studentized Range= 4.066, Minimum Significant Difference= 13.427; * Means with the same letter are not significantly different

TABLE XIX. MULTIPLE MEAN COMPARISON, TUKEY'S STUDENTIZED RANGE TEST (HSD) OF TOTAL CAPTURE (MALES & FEMALES) AT THE DECIDUOUS AREA (FINCA DUEÑAS), 1996

GROUPINGS	MEAN	N	TRAP TYPE
A	26.750	8	OBDT, FA-2
A B	25.687	8	IPMT, FA-2
A B	20.000	8	CBDT, FA-2
A B	18.812	8	JMT, NU+B
B	11.250	8	JT, TML

Alpha= 0.05, df= 35, MSE= 113.198, Critical Value of Studentized Range= 4.066, Minimum Significant Difference= 15.295; * Means with the same letter are not significantly different

4.6. 1996 discussion and conclusions - deciduous area

At this site, the fruit fly population was very low as was host availability (pears and peaches). Data collected during the eight week period showed that, at this elevation, the JT, TML outperformed others in male capture. However, in contrast to other sites, it was last when total trap captures were considered. Female captures were best achieved by the traps using the FA-2 attractants. At this site, the best female captures were achieved by the IPMT, FA-2, the OBDT, FA-2, the CBDT, FA-2 and the JMT, NU+B, respectively. However there was no significant difference between these treatments.

5. 1997/98 STUDIES

5.1. 1997/98 materials and methods

5.1.1. 1997/98 studies in coffee

The field work covered a period of fourteen weeks (from mid October 1997 to the end of January 1998). These tests were conducted from the last part of the rainy season into the dry season. Field work was carried out at three different coffee fincas: San Carlos Miramar (600 m); Valparaiso (625 m); and San Luis (650 m). All fincas were located in the coffee area in southwestern Guatemala, near the Mexican border. These fincas are located within 2 km of each other. The trapping grid at each finca included 4 lines of 14 traps each. Traps were spaced at 50 m between lines and 25 m between traps. The distribution of treatments along the lines was done randomly. Trap servicing was conducted on a weekly basis. The synthetic lures (FA-3 consisting of separate patches of AA, P, and TMA) in all treatments that included them were replaced every four weeks. The NU+B solution in the IPMT was renewed every week. The TML in the JT was replaced every two weeks. Based on trap handling, this test included two phases. During Phase I (first seven weeks) an odorless dish detergent was used as surfactant in the water for the wet traps and the DDVP block (killing agent) was maintained in its commercial size. During Phase II (last seven weeks), the dish detergent was replaced by Triton, a commercial surfactant. And the DDVP block was reduced to 1/4 its commercial size.

At each site, trap evaluations were made using feral flies and sterile flies. Four weeks before the end of this test, aerial applications of SureDye were initiated in the work area.

Statistical analysis consisted of non-parametric ANOVA followed by multiple mean comparison.

The traps used were:

- IPMT baited with FA-3, water and 3 drops of an odorless dish detergent (IPMT, FA-3, wet)
- IPMT baited with FA-3 and the addition of a yellow sticky insert (IPMT, FA-3, dry)
- Tephri trap baited with FA-3, water and 3 drops of an odorless dish detergent (Tephri, FA-3, wet)
- Tephri trap baited with FA-3 and addition of block of DDVP of commercial size (Tephri, FA-3, dry)
- Local trap I - a 2 l plastic soft drink bottle with a bright green bottom baited with FA-3, water and 3 drops of an odorless dish detergent (CC1, FA-3, wet)
- Local trap I - a 2 l plastic soft drink bottle with bright green bottom baited with FA-3 and the addition of a yellow sticky insert (CC1, FA-3, dry)
- Local trap II - a 2 l plastic soft drink bottle with bright yellow bottom baited with FA-3, water and 3 drops of an odorless dish detergent (CC2, FA-3, wet)
- Local trap II - a 2 l plastic soft drink bottle with bright yellow bottom baited with FA-3 and the addition of a yellow sticky insert (CC2, FA-3, dry)
- Local III - a 2 l plastic soft drink bottle with clear bottom baited with FA-3, water and 3 drops of an odorless dish detergent (CC3, FA-3, wet)
- Local III - a 2 l plastic soft drink bottle with clear bottom baited with FA-3 and the addition of a yellow sticky insert (CC, FA-3, dry)
- Glass McPhail trap baited with NU+B (McPhail, NU+B)
- Glass McPhail trap baited with FA-3, water and the addition of 3 drops of an odorless dish detergent (McPhail, Fa-3, wet)
- OBDT dry trap - a locally made, dark green cardboard sheet, baited with FA-3 and the addition of a yellow sticky insert
- JT, TML

5.1.2. 1997/98 studies in a deciduous area

An additional study was conducted in a deciduous area. Field work was conducted at Santa Lucia Milpas Altas, San Bartolomé Milpas Altas and Magdalena Milpas Altas, Sacatepéquez (35 km from Guatemala City). This area had a wild medfly population. Host fruits were: pears, apples, peaches and some backyard coffee. Three types of traps baited with the FA-3 lure were compared to JT, TML. The IPMT, Tephri, and a local trap were evaluated as wet traps and also as wet traps in combination with a yellow sticky panel (23 x 15 cm) with stickum on both sides. The rationale was that an increase in the capture area would increase trap captures. Traps were distributed along three pre-established trapping routes in the trapping network of the local medfly program. Treatments were distributed randomly along the trapping routes. Five traps of each treatment were incorporated in each trapping route. Trap servicing was performed every week. The synthetic lures were replaced every four weeks. The TML plug was replaced every two weeks. The yellow sticky panel was replaced every week. Treatments included in this test included:

- IPMT, FA-3, wet
- IPMT, FA-3, wet, yellow sticky panel
- Tephri, FA-3, wet

- Tephri, FA-3, wet, yellow sticky panel
- CC1, FA-3, wet
- CC1, FA-3, wet, yellow sticky panel
- JT, TML

5.2. 1997/98 results, discussion, and conclusions

5.2.1. Results in coffee areas

Results are shown in Tables XXIII and XXIV.

Based on non-parametric ANOVA followed by multiple mean comparison, there were significant differences between treatments for sterile insect capture at the three fincas during the two periods of experimentation. The JT, TML and the locally made OBDT, FA-3 with yellow sticky insert performed best for sterile insects at finca San Carlos. The JT, TML and the CC2, FA-3, dry with yellow sticky insert were best at finca San Luis. The JT, TML and the CC1, FA-3dry with yellow sticky insert captured the most insects at finca Valparaiso.

The same statistical analyses were used to compare treatments for effectiveness in capturing feral flies at these sites. Data from the first phase of this study showed there were no significant differences between treatments at finca San Carlos. At finca San Luis, the CC3, FA-3, dry with yellow stick insert and the CC1, FA-3, dry with yellow sticky insert performed best. At finca Valparaiso, the CC1, FA-3, dry with yellow sticky insert and the CC2, FA-3, dry with yellow sticky insert caught more flies. During the second phase of the study, only finca Valparaiso reported significant differences. Here the IPMT, FA-3, dry with yellow stick insert and the CC3, FA-3, dry with yellow sticky insert worked best.

For some unknown reason, all wet traps performed poorly in this test. This observation held for the duration of the two phases. It was thought that there might be a possible negative interaction between liquid lures and temperature in this work area.

In these tests, the odor in all wet traps containing synthetic lures was different than the odor in the dry traps with the same lures.

The aerial application of the SureDye bait started on week 10 of the test. At this time, the feral insect population had declined and no releases of sterile insects were conducted in the work area.

The distribution pattern for the feral insect population varied a lot in this test. Based on field observations, crop management could be the factor governing such behavior as crop management strategies were different on each finca.

Future projects should include a cost/benefit approach to the use of these lures and traps.

The synthetic lured performed better in this test and the lures attracted by sexes of medfly, but were more specific for females. The synthetic lures were also less attractive to sterile insects. The JT, TML outcaptured the other treatments for sterile insect captures at all work sites. At sites where significant differences between treatments for feral populations existed, the local traps baited FA-3 lures performed better.

5.2.2. Results in the deciduous area

The results of this test (Table XXV) confirmed previous findings on the efficacy of the synthetic lures for medfly in this deciduous area. In the test, the Tephri, FA-3, wet without the yellow sticky panel gave the best performance. The CC2, FA-3, wet without the yellow sticky panel was next best, while the CC2, FA-3, wet with yellow sticky panel was third. Traps baited with the FA-3 lures always captured a high percent of females. Based on non-parametric statistical analysis, there were significant differences between treatments

TABLE XXIII. CAPTURE OF FERAL MEDFLIES USING DIFFERENT TYPES OF TRAPS AND LURES (IN F/T/D) IN COFFEE, 1997-98

Trap Type	IPMT	IPMT	Tephri	Tephri	CC1 (green)	CC1 (green)	CC2 (yellow)	CC2 (yellow)	CC3 (clear)	CC3 (clear)	Glass McPhail	Glass McPhail	OBDT	Jackson
Bait	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	NU+B	FA-3	FA-3	TML
	Wet	Insert	Wet	Dry	Wet	Insert	Wet	Insert	Wet	Insert	Wet	Wet	Insert	Insert
Location														
San Carlos Miramar weeks 43-49, 1997	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.02	0.00	0.01	0.00	0.01	0.01	0.01
San Carlos Miramar weeks 50-3, 1997-98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Valparaiso weeks 43-49, 1997	0.12	2.78	0.08	0.54	0.08	4.04	0.22	3.79	0.06	3.43	0.33	0.09	3.40	1.83
Valparaiso weeks 50-3, 1997-98	0.00	0.08	0.00	0.00	0.00	0.05	0.01	0.05	0.00	0.08	0.00	0.00	0.04	0.03
San Luis weeks 43-49, 1997	0.00	0.02	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.03	0.00	0.00	0.00	0.01
San Luis weeks 50-3, 1997-98	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00

TABLE XXIV. CAPTURE OF STERILE MEDFLIES USING DIFFERENT TYPES OF TRAPS AND LURES (IN F/T/D) IN COFFEE, 1997-98

Trap Type	IPMT	IPMT	Tephri	Tephri	CC1 (green)	CC1 (green)	CC2 (yellow)	CC2 (yellow)	CC3 (clear)	CC3 (clear)	Glass McPhail	Glass McPhail	OBDT	Jackson
Bait	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	NU+B	FA-3	FA-3	TML
	Wet	Insert	Wet	Dry	Wet	Insert	Wet	Insert	Wet	Insert	Wet	Wet	Insert	Insert
Location														
San Carlos Miramar weeks 43-49, 1997	0.34	0.57	0.80	0.92	0.39	0.68	0.67	0.85	1.29	0.61	0.20	0.59	1.01	7.03
San Carlos Miramar weeks 50-3, 1997-98	1.1	0.36	0.66	0.06	0.43	1.37	0.95	0.71	0.40	1.52	0.08	0.13	0.98	9.63
Valparaiso weeks 43-49, 1997	2.1	7.37	3.32	7.70	4.43	14.86	6.18	8.42	9.45	10.50	5.05	3.81	6.67	22.71
Valparaiso weeks 50-3, 1997-98	0.7	2.16	1.50	0.31	0.54	1.95	1.84	1.37	2.31	3.02	0.99	0.26	2.17	8.31
San Luis weeks 43-49, 1997	0.3	0.91	0.43	0.57	0.82	1.06	0.36	1.65	0.61	1.39	0.29	0.57	1.30	3.43
San Luis weeks 50-3, 1997-98	0.2	0.42	0.32	0.09	0.22	0.55	0.28	0.71	0.06	0.72	0.02	0.18	0.77	1.75

TABLE XXV. CAPTURE OF FERAL MEDFLIES IN A STERILE RELEASE PROGRAM USING DIFFERENT TYPES OF TRAPS AND LURES (IN F/T/D) IN A DECIDUOUS AREA, 1997-98

Trap Type	IPMT	IPMT	Tephri	Tephri	CC1 (green)	CC1 (green)	Jackson
Bait	FA-3	FA-3	FA-3	FA-3	FA-3	FA-3	TML
	Wet	Wet +Insert	Wet	Wet + Insert	Wet	Wet + Insert	Insert
	0.015	0.016	0.034	0.007	0.024	0.024	0.005

6. OVIPOSITION STUDIES

6.1. Materials and methods

6.1.1. Field studies 1995-96

The test was conducted in the coffee area of Antigua, Guatemala. The fruit fly population in the area was moderate (0.08 - 0.1 F/T/D). The trapping grid consisted of 2 lines of 4 traps each. Trap lines were located 50 m apart and the distance between traps along the lines was 20 m. All traps were baited with the FA-3 lures. All traps included one purple and one green agar ball wrapped inside a layer of Parafilm™. The diameter of the agar ball was 3 cm. Food (a mixture of sugar and hydrolyzed protein) and water were provided to insects inside the traps. Traps were serviced (replacement of agar balls) every four days. The test included a total of six check periods. At each check, the insects in the traps were removed from the field to make sure only new insects entered the traps during the following period. Agar balls were transported to the laboratory where egg count and egg hatch were recorded. In order to avoid damage to eggs and also to be able to remove all eggs from the agar balls, a dissecting microscope was used.

6.1.2. Laboratory studies 1995-96

The test was conducted at the USDA/APHIS Methods Development Station Laboratory in Guatemala City. Insects for this study were obtained from the Petapa medfly standard (males and females) strain. At eclosion, insects were gathered into two groups - virgin females and virgin couples. Afterwards, insects were held in clear plexiglass cages (20 x 20 x 20 cm). The cages hosted either 200 virgin females or 100 virgin couples. The variable in the test were: egg production from mated insects; and egg production from unmated insects. Insects in this test deposited eggs either in green agar balls or through a fine mesh screen (where the eggs were collected on wet filter paper). There were two cages for each group of insects. In one cage, eggs were collected in agar balls, and, in the other, they were collected on wet filter paper. During the test, food (a mixture of sugar and protein hydrolysate, 3:1) and water were provided to adult insects. Figures on egg hatch for each treatment are based on a total of 1200 eggs (6 check periods, 200 eggs each period). Egg collection was performed every two days. For the green agar ball collection, both parameters (total egg production and percent egg hatch) were recorded. For the fine screen collection, only percent egg hatch from mated and unmated insects was deemed important.

6.1.3. Field cage study

A second study was also conducted. Two types of trap were included - the OBDT and a Mission Dry Trap (clear plastic). Both traps were modified form their original design, namely gluing a fine screen inner funnel to each entrance hole. Modification was necessary to avoid flies leaving the trap, once they had entered. Each trap type was baited with FA-2 attractants. Traps were hung in the top of field cages. Data were collected on the number of insects retained in the trap and the number of females and males in the trap.

The egging device was a small plastic basket (normally used as a holder for the TML plug). The egging devices were wrapped in a layer of Parafilm™ and filled with the specific egging media except for a natural oviposition substrate (grape). The egging devices containing media were randomly distributed inside the trap along a central axis.

Five egging media were evaluated: grape; agar; Alcosorb; G-400; and Fuselerone. All five media were randomly distributed and hung inside the traps. Exposure of egging media, except for grape, was done inside a layer of Parafilm™. Egging media were exposed to flies for two days. The evaluation parameters recorded were: number of oviposition marks on the outside of the device and the number of eggs in the media.

Medflies for this study came from the MOSCAMED rearing facility. Insects were sexually mature when released. The insect density per cage was 100 males and 100 females. Insects were left in the cages for two days to allow them to enter the traps and encourage egg laying.

Five field cages were used in this study (standard quality control field cages). To evaluate the possible effect of external factors on trap performance, cages were divided clockwise into quadrants for trap location. There were four traps per cage, two of each type. Each trap was assigned a position.

6.1.4. Laboratory studies 1997-98

Tests were conducted at the USDA/APHIS Methods Development Station Laboratory in Guatemala City. Insects for this test were obtained from coffee samples collected in southwest Guatemala. At eclosion, insects were separated into two groups - virgin females and virgin couples. Insects were held in clear plexiglass cages (20 x 20 x 20 cm). The cages hosted either 25 virgin females or 25 virgin couples. The age of the insects at the start of the experiment was 12 days. There were a total of two cages for each group of insects. Egg collection was performed in agar balls (3 balls per cage) every two days. Insects were supplied with food (a mixture of protein and sugar) and water. The test included a total of six check periods similar to studies with the laboratory strain. Periodic percent egg hatch was based on samples of 100 eggs for each treatment. In this test, total egg counts were mandatory for both groups of insects.

6.2. Results, discussion and conclusions

6.2.1. Field studies 1995-96

In this experiment, egg collection from feral medflies was successful under open field conditions. Results are summarized in Table XXVI. Retaining chambers for this type of field work show allow sufficient inner space to properly fit the agar ball(s), lures, food, water, and also provide some resting area for the flies. The average percent egg hatch were low when compared to those for laboratory strains. This could be because a portion of the trapped females were virgin insect that laid eggs in the agar balls. This hypothesis was not investigated under field conditions. Based on non-parametric statistical analysis, there was no significant difference between treatments, either for total numbers of eggs collected, or for percent egg hatch.

6.2.2. Laboratory studies

In this test, laboratory reared unmated female medflies produced eggs under laboratory conditions. The average percent egg hatch for mated insect was 91.33%. The average numbers of eggs/female/day for unmated and mated insects were 20 and 15, respectively. These results are summarized in Table XXVII.

TABLE XXVI. NUMBER OF EGGS COLLECTED AND EGGS HATCHED FROM FIELD COLLECTED FERAL MEDFLIES

	Eggs collected	Standard Deviation	Eggs Hatched	Standard Deviation
Purple agar ball	1206	297.3	66.1	24.5
Green agar ball	400	70.1	59.5	20.3

TABLE XXVII. NUMBERS OF EGGS COLLECTED AND EGGS HATCHED FROM LABORATORY STUDIES USING MATED AND UNMATED FEMALE MEDFLIES

	Eggs collected	Standard Deviation	Eggs Hatched	Standard Deviation
Mated Females	15.5	7.9	91.3	3.2
Un-mated females	19.8	10.4	86.3	4.7

6.2.3. Field cage study

Data are shown in Table XXVIII. Both traps attracted and retained adult medflies. The CBDT, F-2 attracted and retained 30% flies than the Mission, FA-2. Because of differences in light intensity and wind direction, there were some positional effects of trap placement. The sex ratios for insects retained in both trap types did not differ and was close to 1:1. The desirability of ovipositional substrate ranked very similarly for both traps. When comparing figures on total egg collection for both traps and for each media, differences were 48%, 76%, 87%, 73%, and 83% for grape, G-400, agar, Alcosorb, and Fuselerone, respectively, favoring the CBDT, FA-2. Thus, the use of the CBDT, FA-2 should be of help for these kind of studies. This combination looks promising when applied to laboratory reared medflies under confined conditions. The egging substrates evaluated here and new ones, considered in future studies, can simplify egg collection.

6.2.4. Egg production by mated and unmated females under laboratory conditions

In this test, unmated feral females did lay eggs into agar balls. Results are shown in Table XXIX. This was an important finding because, during the field test (see *4.5.1.*), we found a lower percent egg hatch when compared to laboratory studies (see *6.2.1.*). We did not find direct evidence that this occurs in a wild population. The above findings should be taken into consideration when interpreting figures for induced sterility, and also when interpreting results obtained in field cage studies where mating events are not recorded. In these studies, the egg production for mated feral females was double that for unmated females. These results were different than those for laboratory reared insects (see *6.2.1.*). Perhaps egg laying behavior has been modified by lab rearing.

TABLE XXVIII. OVIPOSITION INTO VARIOUS SUBSTRATES IN FIELD CAGE STUDY

Ovipositional Substrate Material	Trap Type				Mission/CBDT egg collection ratio
	CBDT		Mission		
	Number of Eggs	Number of Oviposition Marks	Number of Eggs	Number of Oviposition Marks	
Grape	980	117	510	126	0.5204
Agar	112	70	41	12	0.1314
Alcosorb	322	61	86	26	0.2671
G-400	566	86	131	43	0.2314
Fuselerone	265	56	45	12	0.1698

TABLE XXIX. EGG PRODUCTION BY MATED AND UNMATED FEMALES UNDER LABORATORY CONDITIONS

	Average Oviposition in Agar Balls (Eggs/Female/Day)		Average Percent Egg Hatch in Agar Balls	
Check Period	Mated	Unmated	Mated	Unmated
1	4.6	2.77	80.54	0
2	7	2.83	74.02	0
3	16	7.5	79.72	0
4	17.8	7.56	79.01	0
5	15.08	11.26	78.36	0
6	11.64	8	72.39	0
Average	12.02	6.65	77.34	

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