DEVELOPMENT OF A FEMALE MEDFLY ATTRACTANT SYSTEM IN MOROCCO

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Abstract

Field trials were conducted in Morocco to evaluate food-based attractants according to the FAO/IAEA international network program. Ammonium acetate plus putrescine (FA-2 attractants) were very effective and selective for female medfly attraction. The addition of trimethylamine (FA-3 attractants) increased trap catches. The association of the female attractants with various traps were tested in two medfly host plants, argan (*Argania spinosa*) and mandarin (*Citrus reticulata* Blanco) during two seasons (fall and summer). Open bottom dry traps (OBDTs), closed bottom dry traps (CBDTs), dry International Pheromone's McPhail traps (IPMTs), wet IPMTs, locally made traps and Tephri traps, all baited with the synthetic lures (FA-2 and FA-3), were compared to liquid protein baited IPMTs and Trimedlure baited Jackson traps. Results showed that the new trapping systems were as effective in capturing females as the standard IPMT baited with NuLure + borax. Furthermore, dry Tephri traps were the most effective under certain conditions. Only in one experiment were CBDTs baited with the synthetic two component lure (FA-2) as effective as Trimedlure baited Jackson traps. In most cases the attracted females were immature. Attempts to increase the attractiveness of the synthetic lure by the addition of male medfly synthetic pheromone failed. Based on the results obtained, it is apparent that the three component synthetic female attractant (FA-3) provides an effective system for capturing female medflies and could be used as an alternative to NuLure baited IPMT traps for assessing the efficacy of SIT when sterile males are released.

1. INTRODUCTION

The Mediterranean fruit fly, *Ceratitis capitata*, poses a major problem for fruit production in Morocco. With an annual production of more than 2 million tons, the yearly losses are valued at more than 32 million US dollars, of which $4-5 million per year are spent for insecticide treatments.

The production of the fruits, notably citrus, has been oriented toward finding export markets. The future of horticulture in Morocco depends on remaining competitive with other Mediterranean countries which are producing the same varieties and exporting to the same markets as Morocco. This competitiveness requires the production of citrus of consistently high quality. However, in spite of efforts and encouragement offered to farmers and producers by public services for converting or renewing their trees, the yields have remained weak (<17 ton/ha for the citrus fruits). In general, orchards are old (50% of some varieties are more than 35 years) and the product quality is often poor.

The control of medflies by chemical treatments alone is difficult and causes pollution of the environment. Problems due to overuse of insecticides have been poorly studied but some consequences include proliferation of other pests such as acarina, scales, aphids and aleurothrixus, all of which cause important damage. Also, current strategies for control of medflies prevents the utilization biological control methods. Furthermore, presence of residues in the treated fruit could close some potential export markets, such as Japan and the United States. Recent data shows that even though chemical treatments are applied 8 - 10 times a year in some commercial operations, large proportions of fruits are still infested by medflies. This is because treatments are not made in a coordinated way by regional producers. This poor coordination is due to a lack of precise data on the development cycle of the population in relation to the climatic data and the phenology of the host-plant.

Therefore, the implementation of a sterile insect technique (SIT) program using only sterile males for the control of medflies is a good option which would obviate some of the problems cited above and provide an opportunity for development and diversification of the national production by introduction of other fruit cultures. Biological control strategies could then be developed against other citrus pests such as the citrus leafminer, *Phyllocnistis citrella.*

The development of an attractant for female medflies would improve the SIT technique efficacy by removing feral females, provide data on the population levels and indicate the percentage of sterility introduced in the population of medflies. Significant progress has been made in this regard with the development of a food-based synthetic attractant which uses ammonium acetate and putrescine in association with a dry trap [2]. Addition of trimethylamine (TMA) further increased the potential of the lure for attraction. Further experiments were conducted to find the best association lure - trap which could give maximum female catches. These experiments were launched in a number of countries in Mediterranean area, Central and Latin America to test the trapping system efficacy under various climatic conditions (dry and humid). The International Network Research Project, operated as part of a FAO/IAEA Research Contract Program, was the framework that coordinated this research. Twelve countries were involved in this program for "Development of female medfly attractant systems for trapping and sterility assessment." Reported herein are results from 5 years of field studies in Morocco. We also report on findings from side experiments which were conducted to develop an oviposition device for collecting eggs in order to assess the level of sterility introduced in the wild population.

2. MATERIALS AND METHODS

Experiments were conducted either during summer (high population levels) or autumn-winter (low population levels). The sites of experiment were in argan forest and/or citrus orchard.

The experiment consisted in comparing 4 to 7 trap treatments distributed randomly in 5 experimental block designs and rotated after each check. Traps were checked every 3 - 4 days for a period of 8 weeks and serviced according to each trap requirement. Trap types, the experimental design and the material used were those described in the experimental protocol provided by the IAEA.

2.1. Description of the experimental sites

Argan forest: Argan forests (*Argania spinosa*, Sapotacea) cover 700,000 ha in southwest of the country. It has been reported that this is the largest habitat of medfly in the world [2]. The site of experimentation was localized inside the Institute of Agronomy and Veterinary Sciences of Agadir. This was a convenient place for conducting experiment because there are no children or foraging animals. The plot was not treated with pesticides, and was close to a meteorological station. The site area was around 1 ha.

Citrus orchard: This site was 9 km from Marrakech and localized inside a farm with various fruit crops (mandarin, navel and peach). Traps were deployed within the navel parcel. In other experiments, a citrus site was selected inside the Agadir Institute. During the experiments, fruits were not treated with insecticide. In some cases, fruit had been harvested already.

Climatic conditions: Morocco has a typical Mediterranean climate with hot, dry summers and mild, rainy winters. The experiments were conducted in the central

southwestern part of the country. The altitude is about 20 m at Agadir and 200 m around Marrakech. The average precipitation is 230 mm per year. The average temperature was 29°C maximum and 16°C minimum. The average relative humidity varied between 55 and 98%. In some period of the summer, a hot wind, called Sirocco, blows from the southeast and instantly increases the temperature towards the maximum.

2.2. Traps

1st year: The objective of the first year experiments was to evaluate a new female trapping system for *C. capitata* consisting of a new cylindrical dry trap (closed bottom trap, CBDT) and a combination of two new female attractants (ammonium acetate and putrescine - the FA-2 attractant) which were formulated in long-lasting dispensers by USDA-ARS (Gainesville, FL, USA). A description of lures and traps has been reported [1]. Jackson traps baited with Trimedlure (TML) were included in the experiment as an indicator of medfly population levels. Traps were deployed in argan and citrus in Agadir during fall 1994 and summer 1995.

2nd year: The experiments consisted of comparing the performances of several trap and lure combinations which included: CBDTs with FA-2 lures; FA-2 lures in open bottom dry traps (OBDTs) containing a yellow sticky insert; locally-made open bottom traps with yellow color and yellow sticky insert (CC)[3]; a liquid protein-baited IPMT (aqueous solution of 9% NuLure + 3% borax, NU+B); and Jackson traps baited with TML. The Jackson traps were included as an indicator of the medfly population. Traps were deployed in argan forest and mandarin orchard in Agadir during fall 1995.

3rd year: This year, a third component, TMA, was added to the synthetic lure. The two component, FA-2 lures consisting of patches of ammonium acetate (AA) + putrescine (P) and the three component, FA-3 lures (consisting of AA + P + TMA) were tested in OBDTs and CC traps. A new "Frutect" medfly trap (a trap with a red spherical container containing a special formulation of liquid protein bait mounted on a yellow sticky board) was also tested. As in year 2, these were compared to IPMTs baited with NU+B and Jackson traps baited with TML. All traps were deployed in an orange orchard. The field trial was conducted during fall 1996.

4th year: The lure was improved by the addition of a third component, TMA. Additionally, preliminary experiments carried out in Guatemala [4] using IPMTs with water in the reservoir and, in Spain with the Tephri trap, using DDVP showed that these traps out-captured the OBDTs. The purpose of experiments this year was to test the FA-3 lures in wet and dry traps to differentiate between trap design and presence of water in the trap. These tests included: IPMTs using water or DDVP for fly retention; Tephri traps with DDVP; and OBDTs + yellow sticky insert + medfly synthetic pheromone on a rubber bung sleeve (provided by Dr. Howse). As in the previous experiments, Jackson traps with TML and IPMT traps with liquid protein were used as standards.

Lures provided this year were commercially produced and slightly different than those provided in previous years. The FA-3 components were individually packaged in a white envelope labeled "Biolure"

2.3. Side experiments

The maturity status of captured female medflies was determined via dissection and examination of ovaries. A sub-sample of 25 - 30 females was collected from each trap.

The development of an egging system using female attractant or argan extract failed.

2.4. Data analysis

The results obtained were submitted to the variance analysis and means were separated with least significant test or Tukey's test. The original data were log (x+1) transformed. Tables show non-transformed data.

3. RESULTS AND DISCUSSION

From the results of field trials conducted during the fall of the first year field (Table I), it was apparent that the food-based synthetic attractants provided an effective system for capturing female medflies. More than 90% of females were captured by FA-2 baited traps but only 5% of males. Catches in Jackson traps indicated that the population levels were moderate, which is normal for this time of year.

When the same experiment was repeated during summer, when the medfly populations were high in argan forest, dry traps caught almost 100% of total females and this represented 73% of dry trap catches. Analysis of variance of log (x + 1) transformed data followed by least significant difference test indicated that the mean number of females in dry traps was significantly lower than the mean number of males in Jackson traps (Table II). However, the total number of flies caught in both male and female targeted traps was not significantly different (F=0,63; dl 1,63; $P > 0,05$). This promising data should be analyzed with care since trap capacity was a limiting factor for fly catches in Jackson traps. Indeed, during the summer experiments, Jackson traps were 100% saturated when dry traps could still be filled. In addition, FA-2 baited dry traps were slightly specific for medflies. Further experiments were conducted to compare this new female trapping system with the standard IPMT, NU+B system. Also, other traps were tested with the new female attractant to acquire more knowledge about the relation between trap designs and climatic conditions. In this regard, the OBDT and the local CC trap, both baited with FA-2 were also tested. Tables III and IV show that trap captures in both argan and citrus were similar and lower than in the summer experiment. The food-based synthetic attractant was designed to be used mainly for monitoring and controlling medfly population. Therefore, tests at low population level would give more information concerning the performance of the attractant. Trap captures in Jackson traps ranged from 0.93-0.58 males/trap/day in argan and citrus, respectively, representing 51 - 60% of total captures. During the summer, trap captures reached 47 males/trap/day in argan, and represented 47.8% of total catches. Traps with FA-2 attractants and IPMT, NU+B captured the most females in the test and there were no significant differences in capture among any of the female targeted-traps. Female capture ranged from 0.06 - 0.20 females/trap/day and representing 58-88 % of the trap capture. If only females are considered, ANOVA followed by Tukey's test indicated that IMPTs attracted significantly more females than the other traps. TML baited Jackson traps captured almost no females at both sites. At low populations, trap efficiency comparisons demonstrated that TML baited Jackson traps were still the best for attracting a large number of medflies, but 80-82% of these were males. A trap which can remove females is considered more significant in pest control because females cause the most fruit damage.

In decreasing order, Jackson traps were the most medfly specific, followed by OBDT, CBDT, CC, and IPMT traps. It seems that argan has lower insect diversity than citrus. The highest percentage of non-target insects was caught in citrus and reached 25% of total capture of CC traps.

TABLE I. *Ceratitis capitata* CAPTURE IN JACKSON TRAPS BAITED WITH TML AND CBDT BAITED WITH FA-2 DURING FALL 1994 IN ARGAN FOREST

Trap/lure/treatment			Flies/trap/day			Relative trap efficiency (in %)		
Trap	Bait	Retention	Male	Female	Total	Male	Female	Total
JT	TML	Sticky Insert	3.26	0.02	3.28	94.7	6.5	87.5
CBDT	FA-2	methomyl	0.18	0.29	0.47	5.3	93.5	12.5
		TOTAL	3.44	0.31	3.75	100	100	100

TABLE II. *C. capitata* CAPTURE IN JACKSON TRAPS BAITED WITH TML AND CBDT BAITED WITH FA-2. FIELD TRIAL CONDUCTED IN ARGAN FOREST DURING SUMMER 1995

Trap/lure/treatment			Flies/trap/day			Relative trap efficiency (in %)		
Trap	Bait	Retention	Male	Female	Total	Male	Female	Total
JT	TML	Sticky Insert	47.4	0.002	47.4	77.2	0	47.8
CBDT	FA-2	methomyl	14.0	37.8	51.8	22.8	100	52.2
		TOTAL	61.4	37.802	99.2	100	100	100

TABLE III. MEAN FLIES/TRAP/DAY CAPTURED WITH MALE-TARGETED JACKSON TRAPS BAITED WITH TML AND WITH FEMALE-TARGETED TRAPS (OBDT, CBDT, LOCAL TRAP, IPMT) BAITED WITH EITHER FA-2 OR NU+B. FIELD TRIALS CONDUCTED IN ARGAN FOREST IN FALL 1995

Trap/lure/treatment			Flies/trap/day			Relative trap efficiency (in %)		
Trap	Bait	Retention	Male	Female	Total	Male	Female	Total
JT	TML	Sticky Insert	0.93	0.00	0.93	80	0	60
CBDT	FA-2	methomyl	0.04	0.07	0.12	4	19	7
OBDT	FA-2	Sticky Insert	0.05	0.08	0.12	4	20	8
Local trap	FA-2	Sticky Insert	0.06	0.08	0.14	5	21	9
IPMT	NU+B	Water	0.09	0.15	0.24	8	39	16
		TOTAL	1.17	0.38	1.55	100	100	100

TABLE IV. MEAN FLIES/TRAP/DAY CAPTURED WITH MALE-TARGETED JACKSON TRAPS BAITED WITH TML AND WITH FEMALE-TARGETED TRAPS (OBDT, CBDT, LOCAL TRAP, IPMT) BAITED WITH EITHER FA-2 OR NU+B. FIELD TRIALS CONDUCTED IN CITRUS (MANDARIN) IN FALL 1995

Trap/lure/treatment			Flies/trap/day			Relative trap efficiency (in %)		
Trap	Bait	Retention	Male	Female	Total	Male	Female	Total
JT	TML	Sticky Insert	0.58	0.00	0.59	82	1	51
CBDT	FA-2	methomyl	0.03	0.10	0.14	4	24	12
OBDT	FA-2	Sticky Insert	0.01	0.06	0.08	2	14	7
Local trap	FA-2	Sticky Insert	0.01	0.07	0.08	2	15	7
IPMT	NU+B	Water	0.07	0.20	0.27	10	46	23
		TOTAL	0.70	0.43	1.16	100	100	100

Further improvements were made to increase the efficacy of the new trapping system. In this regard, a third component, TMA, was added to the FA-2 lure. Since trap design may have an effect on the capacity of capture, experiments were carried out using the same trap for comparing the FA-3 to the FA-2 attractants. IPMTs with NU+B and TML baited Jackson traps were used as standards. The field trial results (Table V) show that traps baited with either the FA-2 or FA-3 synthetic lure captured as many females as the liquid protein baited IPMT and Frutect traps. However, female targeted traps baited with the synthetic lure were more specific. IPMT and Frutect traps attracted, in addition to medflies, *Bactrocera oleae* males and females, *Musca domestica*, spiders and other unidentified diptera. Jackson traps caught at least 30% more flies than the rest of the traps. It seems that trap design had no effect in this case and the third component did improve the new trapping system. In this experiment,70 to 90 % of the dissected females caught in female-targeted traps were mature (90% in liquid protein-baited traps, 80% in FA-2 baited traps and 70% in FA-3 baited traps).

Frutect traps were not easy to use in the field because of the sticky surface collected dust and was difficult to handle. In other countries (Greece and Spain), wet IPMT traps baited with the FA-3 lures captured the highest number of females. For this reason, further experiments were conducted in two medfly host plants, argan and mandarin (*Citrus reticulata* Blanco). The aim of these tests was to evaluate the efficacy of the FA-3 lure in association with wet IPMTs (with water) or dry IPMTs (with DDVP), dry Tephri traps (with DDVP), and OBDTs baited with FA-3 to which a rubber bung loaded with synthetic male pheromone was added. TML baited Jackson traps and NU+B baited IPMTs were used as standards. Tables VII and VIII show that the synthetic FA-3 lures tested in wet and dry IPMTs seem to be as attractive for females as the standard IPMT, NU+B. However, in citrus, the daily average of female captures was significantly higher in Tephri traps baited with the FA-3 lure than in other traps. Contrary to previous results [5], addition of pheromone components to the FA-3 lure in cylindrical open dry traps (with sticky insert) did not increase trap catches. It is not yet known if the inconsistent results with the pheromone were due to the component instability or to other factors. The capture in TML baited Jackson traps ranged from 44 - 17 males/T/D in

TABLE V. COMPARISON OF MEAN NUMBER OF FLIES/TRAP/DAY CAPTURED WITH MALE-TARGETED JACKSON TRAPS BAITED WITH TML AND WITH FEMALE-TARGETED TRAPS (OBDT, LOCAL TRAP) BAITED WITH EITHER FA-3 OR FA-2 SYNTHETIC LURES. IPMT AND FRUTECT BAITED WITH LIQUID PROTEIN WERE INCLUDED IN THE TEST. FIELD TRIALS CONDUCTED IN CITRUS (MANDARIN) IN FALL 1996

Trap/lure/treatment			Flies/trap/day			Relative trap efficiency (in %)		
Trap	Bait	Retention	Male	Female	Total	Male	Female	Total
JT	TML	Sticky Insert	8.27	0.02	8.29	86	0	41
OBDT	FA-2	Sticky Insert	0.15	1.25	1.40	2	12	7
OBDT	FA-3	Sticky Insert	0.41	2.75	3.16	4	26	16
Local Trap	FA-2	Sticky Insert	0.25	2.75	3.00	3	26	15
Local trap	FA-3	Sticky Insert	0.20	1.58	1.78	2	15	9
IPMT	NU+B	Water	0.14	1.23	1.37	1	12	7
Frutect	Frutect Bait	Sticky	0.20	1.11	1.31	2	10	6
		TOTAL	0.70	0.43	1.16	100	100	100

argan and citrus, respectively, which represented only 35 - 50% of total capture, while in the first, second and third year captures in Jackson traps represented 50 to 87 %. NU+B baited IPMT traps were more effective for female capture than all types of dry traps baited with FA-2 lures and their capture ranged from 39 - 46% versus 14 - 24 in dry traps. However, when the third component was added, the dry traps, mainly the OBDT, were twice as effective as NU+B and the Frutect. Only the locally-made traps showed a decrease in female capture when the third component was added, but still captured more females than IPMT, NU+B traps. Furthermore, the relative efficiency of NU+B baited IPMTs was lower or equal to IPMTs with the FA-3 synthetic components and ranged from 13 - 22% in citrus and argan, respectively. This means that trap design has no effect, but the type of lure affects the trap efficiency.

The percentage of females caught in each female-targeted trap ranged from 58 - 92% and this seemed not to be not related to host-plant or the season of experiment. The proportion of females in NU+B baited IPMTs followed the same trend as well.

In citrus, female captures in all female targeted traps were significantly and negatively correlated with minimum relative humidity and minimum temperature. Captures in Jackson traps were not affected by weather conditions. Data from all traps indicated that the population levels in both hosts was gradually declining throughout the experiment.

The IPMTs baited with NU+B were far less specific and caught 50% of total non-target flies in all female-targeted traps, followed by wet IPMTs (30%), dry IPMTs (11%), Tephri traps (4%) and cylindrical dry traps (3.6%). The non-target species captured were mostly ants, spiders and small unidentified black diptera. The fruit infestation level was similar in both hosts and ranged from 10 - 11%.

During the first phase of experiments, the ratio of immature/ mature females changed during the course of both fall and summer experiments conducted in argan. Dissection of a sub-sample of 30 females caught every 3 days indicated that in summer only 39% of captured females were immature while in fall 57% were immature (Table VI). In the second phase of the experiment, conducted in fall, dissection and observation of female ovaries indicated that percent of immature females was 62 and 70% in citrus and argan, respectively. Only in the case of argan was there a significant difference between immature and mature females. In the third year tests, conducted in citrus, during fall, only 10 - 30% of females were immature. From the results of the last year, most of females captured in female-targeted traps were immature. The percent of sexually immature females was 80% and 82% in citrus and argan, respectively. In NU+B baited traps the percentage of immature females ranged from 84 - 87%.

It seems that the ratio of immature/mature females in medfly population changed during the different field tests, and this variation occurred regardless of the season of the test.

Percentages of fruit infestation (Table VI) varied according to the stage of maturity of the fruits. In general, it was high in summer, in argan, when fruits were mature and in fall, in citrus, when fruits became mature and had not been chemically treated for a long period.

TABLE VI. PERCENTAGE OF IMMATURE FEMALES CAUGHT IN FEMALE TARGETED TRAPS BAITED WITH SYNTHETIC FEMALE ATTRACTANT OVER 4-YEAR TRAPPING RESULTS

	% IMMATURE FEMALES	HOST- PLANT	SEASON	% infestation
1st year	39%	ARGAN	Summer	65-85%
	57%	ARGAN	Fall	0-20%
2nd year	60%	CITRUS	Fall	10-30%
	70%	ARGAN	Fall	0-10%
3rd year	10 - 30%	CITRUS	Fall	70- 85%
4th year	80%	CITRUS	Summer	10%
	82%	ARGAN	Summer	11%

TABLE VII. REPRESENTATIVE DATA SUMMARY

Country:	MOROCCO
Host:	ARGAN
Altitude:	60m
Avg. Temp. Min-Max:	16.5 - 29.8 °C
Avg. RH. Min-Max:	54.9 - 97.7
Trapping period (dates):	28 July - 4 September 97
No. of Trap Days (#traps per treatment x #days):	5 Traps x (6wk x 7) = 210
Jackson trap capture (# Total F/T/D):	44.2
% females in Jackson trap ([# Females/ # Total] x 100):	0.00%
Number of Jackson trap days (# traps x # days):	5 x (6 wk x 7) = 210
Average number of larvae/kg fruit:	103 pupae/kg fruit

TRAP/LURE			FLIES/TRAP/DAY			Relative Trap Efficiency			%fem/trap
Trap	Bait	Retention	#Males	# Females	#Total	%Males	%Females	%total	(#fem/#tota
IPMT	NU+B	Water	3.74	5.16	8.9	26	22	23	58
IPMT	FA-3	Water	2.96	6.03	8.99	21	25	24	67
IPMT	FA-3	DDVP	3.19	5.14	8.33	22	22	22	62
TEPHRI	FA-3	DDVP	2.43	4.1	6.53	17	17	17	63
OBDT	FA-3	Sticky	2.05	3.3	5.35	14	14	14	62
JT	TML	Sticky	44.2	0.005	44.205	##########	#########	##########	#########
						100%	100%	100%	

TABLE VIII. REPRESENTATIVE DATA SUMMARY

Country:	MOROCCO
Host:	CITRUS
Altitude:	60m
Avg. Temp. Min-Max:	16.5 - 29.8 °C
Avg. RH. Min-Max:	54.95 - 97.7
Trapping period (dates):	28 July - 4 September 97
No of Trap Days (# traps per treatment x # days):	5 traps x (6 wk x 7days) = 210
Jackson trap capture (#Total F/T/D):	17.31
% females in Jackson trap ([# Females/ #Total]x100):	0.00%
Number of Jackson trap days (# traps x # days):	5 x (6 wk x 7days) = 210
Average number of larvae per kg of fruit:	LARVAE NOT DETECTED, ONLY PUNCTURES WERE OBSERVED, AVERAGE INFESTATION LEVEL 10%.

TRAP/LURE			FLIES/TRAP/DAY			Relative Trap Efficiency			%fem/trap
Trap	Bait	Retention	#Males	# Females	#Total	%Males	%Females	%total	(#fem/#total)
IPMT	NU+B	Water	0.67	1.56	2.23	14	13	13	70
IPMT	FA-3	Water	1.16	2.78	3.94	23	23	23	71
IPMT	FA-3	DDVP	0.73	2.35	3.08	15	20	18	76
TEPHRI	FA-3	DDVP	1.63	3.59	5.22	33	30	31	69
OBDT	FA-3	Sticky insert	0.75	1.67	2.42	15	14	15	69
JT	TML	Sticky insert	17.31	0	17.31	##########	##########	##########	##########
					Total=	100%	100%	100%	

4. CONCLUSIONS

The finding from these field trials showed that significant progress was made in developing a female medfly attractant. The dry Tephri trap baited with the FA-3 lure is satisfactory and fulfills the requirements for use in dry and dusty areas as an alternative to NU+B baited IPMTs. We should also mention that, in only one case (CBDT baited with FA-2 lure), did the female-targeted traps reached the level of Trimedlure baited Jackson traps captures (37 versus 47 female/trap/day). Based on these results, it is apparent that the synthetic attractants provide an effective system for capturing female medflies and could be used as a tool for assessing the efficacy of SIT when sterile males are released. Further programs should be implemented to evaluate the potential for use of the synthetic attractants in mass-trapping strategies for feral females, in addition to use with sterile male release programs.

It is not clear if the synthetic lure is more mature or immature female oriented. Attraction of mature females could be explained by their need to feed on protein as an exogenous source for egg development, but the attraction of immature females shows that there must be another reason.

Captures in traps baited with the FA-3 attractants were mainly affected by changes in minimum relative humidity and minimum temperature. When humidity and temperature decreased, female catches decreased as well.

Development of an oviposition device using argan extract as attractant was promising in the laboratory, but, as yet, field tests have not been as successful. Preliminary identification of argan airborne volatile components revealed that the earlier peaks correspond to the so-called " general green leaf volatiles," viz. hexanol, hexanal, hexenol and hexenal. Tests of medfly response to these components in the laboratory and in the field were also disappointing.

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