MEDFLY (*Ceratitis capitata* Wiedemann) FEMALE ATTRACTANT STUDIES AND DEVELOPMENT OF TRAPPING SYSTEMS FOR STERILITY ASSESSMENT

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Abstract

In four years of research, we evaluated different traps (McPhail, Tephri, Closed-bottom dry trap, Open-bottom dry trap, and Frutect), lures (FA-2 and FA-3 synthetic lures composed of ammonium acetate + putrescine, and ammonium acetate + putrescine + trimethylamine, respectively), and insect retention methods (water, sticky inserts, insecticides) to develop a selective trapping system for female Mediterranean fruit fly (*Ceratitis capitata*, Wiedemann) sterility assessment. The trapping systems were compared with protein-baited McPhail traps, which are the standard method for *C. capitata* female capture, during eight to fifteen week trials in coffee and orthanique orange plantations at two different localities in Honduras. Trimedlure-baited Jackson traps were also used as the standard indicator of the *C. capitata* populations. The Closed-bottom trap baited with the two-component synthetic lure captured eight to twelve times fewer *C. capitata* than the Jackson trap. The McPhail trap and the modified Open-bottom trap, both baited with the two-component synthetic lure, captured 1.6 to 3.5 times more *C. capitata* females than the protein-baited McPhail trap. The addition of trimethylamine to the two-component synthetic lure resulted in 9.8 to 15.8 times increases in *C. capitata* female capture over the protein-baited McPhail trap. The presence of water in McPhail or Tephri traps did not affect the capture of *C. capitata* females. Throughout the study, all female-targeted trapping systems captured the same proportion of females.

1. OBJECTIVES

The goals of the Co-ordinated Research Program were to develop attractants for adult female Mediterranean fruit flies (*Ceratitis capitata*, Wiedemann) for use in Sterile Insect Technique (SIT) eradication or control programs and to compare currently used traps to newly-developed, female-targeted, dry traps with synthetic attractants in various host plants under different environmental conditions.

2. MATERIALS AND METHODS

2.1. Description of the experimental regions

The experiments were conducted in two different localities of Honduras. The regions selected were the Comayagua Valley and the Lake Yojoa basin. The Comayagua Valley is Honduras' most important horticultural zone, with substantial areas planted with several fruit fly hosts. Coffee is the favored host crop for *C. capitata* in Honduras and is cultivated mostly in large areas in the mountains bordering the valley. The predominant natural vegetation in the valley is tropical, deciduous, dry forest. Weather in Comayagua is classified as semi-arid. The average annual rainfall is 752 mm per year ranging in average from of 6.7 to 183 mm per month. On average, it rains of 83 days a year. The rainy season extends from June to November, but it rains the most in May and October. The average temperature is 23.8 °C ranging from an average of 17.4 (9.5 °C absolute minimum) to 31.9 °C (37.5 °C absolute maximum). The average relative humidity throughout the year is 67%. The prevailing winds come from the northeast and the east, with low medium wind speeds between 0.4 and 2.2 m/s; it is calm 41.2% of the time. In contrast, the Lake Yojoa basin is a mountainous region, with large plantations of pineapple (non host), coffee (*C. capitata* hosts), citrus (tangerine, sweet orange and grapefruit which are *C. capitata* hosts and Persian lime) and food crops (corn, kidney beans and beans). The predominant natural vegetation is classified as tropical-humid.

Dominant soils are ultisol, entisol and vertisol. Weather in Yojoa is humid with an average annual rainfall of 3,045 mm ranging from 0 to 535 mm per month. On average, it rains 196 days a year. The rainy season extends from May to November, but it rains the most in September. The average temperature is 22.1 °C ranging from an average of 18.0 (11.0 °C absolute minimum) to 30.9 °C (38.8 °C absolute maximum). The average relative humidity throughout the year is 77%. This data is from 1944 to 1997 and was provided by the Direction of Water Resources, Ministry of Natural Resources, Honduras.

2.2. Host plants and experimental sites

All experiments were carried out in coffee (*Coffea arabica* cv. Catuai) plantations except in 1997 when we used an orthanique orange plantation (*Citrus reticulata*) in Yojoa. In Honduras, these host plants usually have moderate to high infestation of *C. capitata*. All the experiments in Comayagua were conducted in the same six to ten-year-old coffee plantation (23 ha). The plantation is not shaded, the terrain is flat, the harvest occurs from September to December, and the trees are planted at 1.6 x 1.0 m. The plantation is in the village Las Mercedes 2 km northeast of Tegucigalpa, at an altitude of 680 m above sea level. For experiments in Yojoa, in 1994, we used a 12 year old coffee plantation (5.6 ha) and, in 1997, we used a 14 year old orthanique orange (*Citrus reticulata*) plantation (10 ha). Both plantations are located in the village La Ceibita, 8 km east from the village of Santa Cruz de Yojoa, Cortés, 115 km north of Tegucigalpa, at an altitude of 280 m above sea level. The coffee plantation is on an inclined terrain, is heavily shaded, the harvest occurs from October to January, and the trees are planted at 1.5 x 2.0 m. The orthanique orange plantation has moderate slopes, is harvested from January to March, and the trees are planted at 6.0 x 5.5 m. For the 1995 and 1996 experiments in Yojoa, we used a lightly shaded 10 to 11 year old coffee plantation located 3 km north of Peña Blanca, 103 km north of Tegucigalpa, at an altitude of 265 m above sea level. The plantation in on a flat terrain, the harvest occurs from October to January and the trees are planted at 2.0 x 1.2 m.

2.3. Description of the female-targeted trapping systems and experimental treatments

All the treatments, including traps and lure combinations per year, are described in Table I. For simplicity, we will use the name in the parenthesis of each treatment description in Table I to identify the treatments in the rest of the tables. All McPhail traps were International Pheromone's McPhail trap.

2.4. Experimental design, data collection and analysis

An experimental site consisted of 2 - 7 treatments placed on 5 lines (A-E) arranged in a randomized complete block design, thus each line represented a block in the experiment. In 1994, each treatment was duplicated in each block. The treatments were located at random within each line at a distance of 25-30 m from each other. The traps were placed on the coffee plants or orthanique trees 2 m above the ground in the southeastern side of the canopy. Twice a week, each trap was examined and the number of female and male *C. capitata* captured was recorded. Except for the 1995 trials, all other experiments carried out in Yojoa lasted for 8 consecutive weeks. The 1995 experiment in Yojoa ran for 15 consecutive weeks. Treatments were rotated sequentially within each line after each check. The traps were evaluated during the morning (9 - 11 a.m.) on the first and fourth day of the week. At each sampling date, water was added to the treatments as needed. Liquid protein attractants (NU+B) were replaced weekly, Trimedlure attractants were replaced every two weeks and the two or three-component, synthetic lure (FA-2 or FA-3) was replaced every four weeks. The attractant used with the Frutect trap was never replaced. The spent materials (water, attractants, foil or clear coverings) were always collected in plastic containers and carefully removed from the experimental sites for disposal.

TABLE I. TREATMENTS USED DURING THE FOUR YEARS OF STUDY FOR DEVELOPMENT OF A FEMALE-TARGETED MEDFLY (*Ceratitis capitata*, Wiedemann) TRAPPING SYSTEMS IN HONDURAS AT COMAYAGUA AND YOJOA FROM 1994 TO 1997

Treatment	Year			
	94	95	96	97
Trimedlure-baited Jackson trap - a triangular 12.7 x 9.5 x 8.5 cm high white cardboard trap with a white sticky insert to capture the flies (JT, TML)	X	X	X	X
Protein-baited McPhail trap - a trap with two detachable plastic containers - a transparent top section (12.7 cm long x 16.5 cm diameter) and a yellow bottom section (8 cm long x 17.5 cm diameter) with aninvaginated area (8 cm x 5.5 cm diameter) which allowed for fly entry and created space for a liquid attractant (300 ml of an aqueous solution containing 9%NuLure + 3% borax) (IPMT, NU+B)		X	X	X
Frutect trap and lure® (RonPal Ltd. Rishpon, Israel) (Frutect) - a trap with a yellow flat, rhomboidal, sticky surface (29 x 29 cm plastic surface with a 11.5 cm diameter hole in the center). In the center was a dark purple plastic sphere of 11.5 cm diameter containing the lure (Frutect)			X	
Closed-bottom, light green, dry trap with two-component synthetic lure (ammonium acetate + putrescine) and with a toxicant square (Diazinon® + sugar) to capture the flies [1] (CBDT, FA-2)	X	X		
Open-bottom, opaque green, dry trap baited with two-component synthetic lure (ammonium acetate + putrescine) and with a yellow sticky insert to capture the flies [2] (OBDT, FA-2)		X	X	
Open-bottom, opaque green, dry trap baited with three-component, synthetic lure (ammonium acetate + putrescine + trimethylamine) and with a yellow sticky insert to capture the fliesOBDT, FA-3)			X	X
McPhail trap baited with the two-component synthetic lure (ammonium acetate + putrescine) and with 300 ml of water to capture flies (IPMT, FA-2, wet)		X	X	
McPhail trap baited with the three-component, synthetic lure (ammonium acetate + putrescine + trimethylamine) and with 300 ml water + 2 drops surfactant to capture flies (IPMT, FA-3, wet)			X	X
McPhail trap baited with the three-component, synthetic lure (ammonium acetate + putrescine + trimethylamine) and with a tablet (2mm x 1.5mm x 0.4 mm) of DDVP (synthetic insecticide) to capture flies. (IPMT, FA-3, dry)				X
Tephri trap (Agro Alcoy, Alicante, Spain) baited with the three-component, synthetic lure (ammonium acetate +putrescine + trimethylamine) and with 200 ml of water and two drops of surfactant to capture flies. The rap was made of two attachable plastic containers an uppertranslucid section (4.0 cm long x 12.5 cm diameter) which gave support to the trap and a lower yellow section (11.5cm long x 12.5 cm diameter) with aninvagination (4.0 cm x 3.0 cm diameter) which allowed for entry of flies and also created an area to contain liquid attractant. (Tephri, wet)				X
Tephri trap baited with the three-component, synthetic lure (ammonium acetate + putrescine + trimethylamine) and with a tablet (2 mm x 1.5 mm x 0.4 mm) of DDVP (synthetic insecticide) to kill the flies (Tephri, dry)				X

The analysis of variance (ANOVA) was conducted using Minitab, Version 11 [3]. Mean separation procedures were conducted using Duncan's new multiple range test at 95% confidence. To show the differences between FA-2 and FA-3 lures and wet and dry traps, mean linear contrasts between IPMT and OBDT traps in 1996 and IPMT and Tephri traps in 1997 were conducted using Sheffe's method for multiple range with 95% confidence [4]. JT, TML traps are highly selective for *C. capitata* males. Thus, treatments with the Jackson trap were dropped from the analysis of variance, except in 1994, when no female-targeted standard was included. To meet the assumption of normality, data was transformed to $\log_{10}[x + 1]$ or sqrt (x). For the analysis of selectivity of the trapping systems, the sum of females and males captured was calculated for each trap for the whole period. Then, the percentage of females captured per trap was calculated using # females / (# males + # females). Treatments which captured no females during the whole experiment were dropped from the analyses.

3. RESULTS AND DISCUSSION

3.1. Efficiency in capturing adult *C. capitata*

During 1994, we evaluated a newly-developed, light green, CBDT baited with a FA-2 synthetic lure and a toxicant described in [1]. We compared this CBDT with a male-targeted JT. The number of *C. capitata* captured by each treatment is shown in Table II. The JT captured 8 to 12 times more *C. capitata* flies and 6 to 8 times more *C. capitata* females than CBDT (Table II). The poor efficacy observed with the CBDT was thought to be derived from either a faulty trap design, a weak attractant or an ineffective capture device. We concluded that further research was required to test the attractants in other trap types to isolate the trap effect from the lure effect, and to test other improved closed-bottom trap designs with a more effective trapping device.

In 1995, we tested an opaque green trap named the Open-bottom trap (OBDT) with two-component synthetic lure (FA-2) described in [2]. This trap had an open bottom and a yellow sticky insert to capture the flies (Table I). The experiment also included the CBDT tested the previous year and the IPMT. All the traps were baited with the FA-2 to isolate the trap effect from the lure effect. The protein-baited IPMT was also included as the standard, female-targeted trap and the JT as an indicative of the *C. capitata* populations (Table I).

The *C. capitata* population in 1995 measured by the JT capture was 5 to 14 times higher than in the 1994 and 9 times higher in Comayagua than in Yojoa. The CBDT captured similar numbers of *C. capitata* females in both localities, despite the differences in *C. capitata* population density. The OBDT always captured significantly more *C. capitata* females than its predecessor, the CBDT (Table III). The OBDT was also as effective as the IPMT with the same attractant in Yojoa and as the standard in Comayagua. IPMTs and OBDTs with the FA-2 lure, captured more or similar, but never fewer *C. capitata* females than the standard (Table III). We concluded that the CBDT was not fit enough to test again. The FA-2 synthetic attractant was as effective as the standard protein attractant but further improvement would be required to compete in commercial trapping. The OBDT was as effective as the standard IPMT and should be included in further tests.

In 1996, we compared the original two-component, synthetic lure with a new three-component (FA-3) synthetic lure [5]. The new FA-3 lure had the same two-components tested in the first and second year (AA + P) plus trimethylamine (TMA) as the third component.

TABLE II. AVERAGE ±SD OF TOTAL (BOTH SEXES) AND FEMALE *C. capitata* CAPTURE PER TREATMENT AT LAS MERCEDES, COMAYAGUA AND LA CEIBITA, YOJOA FROM APRIL TO DECEMBER 1994

Comayagua				Yojoa			
Treatment	Daily capture[1]		Relative	Treatment	Daily capture[1]		Relative
Total (both sexes) *C. capitata* capture							
JT, TML	0.0721 ±0.116	a	8	JT, TML	0.0223 ±0.029	a	12
CBDT, FA-2	0.0089 ±0.027	b	1	CBDT, FA-2	0.0018 ±0.006	b	1
F= 103.98 df= 1, 319 P < 0.0001				F= 118.21 df= 1, 319 P < 0.0001			
	Daily capture				Daily capture		
Female *C. capitata* capture							
JT, TML	0.0282 ±0.052		6	JT, TML	0.0124 ±0.019		8
CBDT, FA-2	0.0046 ±0.016		1	CBDT, FA-2	0.0016 ±0.006		1

[1] Treatments followed by the same letter are not statistically different (ANOVA on sqrt (x) transformed data.

TABLE III. AVERAGE ±SD FEMALE *C. capitata* CAPTURE PER TREATMENT AND BOTH SEXES ±SD CAPTURE IN JACKSON TRAP AT LAS MERCEDES, COMAYAGUA AND PEÑA BLANCA, YOJOA IN 1995

Comayagua				Yojoa			
Treatment	Daily capture[1]		Relative[2]	Treatment	Daily capture[1]		Relative[2]
IPMT, FA-2	1.332 ±1.85	a	1.63	OBDT, FA-2	0.135 ±0.56	a	3.55
IPMT, NU+B	0.818 ±2.03	b	1	IPMT, FA-2	0.122 ±0.28	a	3.21
OBDT, FA-2	0.754 ±2.46	b	0.92	IPMT, NU+B	0.038 ±0.15	b	1
CBDT, FA-2	0.029 ±0.09	c	0.03	CBDT, FA-2	0.027 ±0.1	b	0.71
F= 29.54 df= 3, 319 P < 0.0001				F= 9.52 df= 3, 599 P < 0.0001			
JT, TML	1.064 ±2.55	n/a	n/a		0.110±0.20	n/a	n/a

[1] Treatments followed by the same letter are not statistically different (ANOVA, Duncan's multiple range test on transformed sqrt(x) data, α= 0.05, df = 3, 312 and 592 for Comayagua and Yojoa, respectively).
[2] Relative to the IPMT, NU+B which is the standard female-selective trapping system.

The FA-2 and FA-3 lures were tested in the OBDT and in the IPMT. The Frutect trap and lure (RonPal Ltd. Rishpon, Israel), a newly patented female-selective trapping system, was also tested in this study. As in the previous years, the protein-baited IPMT, NU+B and the JT were included as the female standard trapping system and as the indicator of the *C. capitata* population density, respectively (Table IV).

Ceratitis capitata population density, as measured by the JT captures, was similar in both localities in 1996, but it was 0.4 to 4 times the population of 1995 and 3 to 10 times the population of 1994 (Tables II, III and IV). All the treatments ranked consistently in both localities. The IPMT and the OBDT with either FA-2 or FA-3 synthetic lures captured significantly more *C. capitata* females than any other female-targeted trap and 3.4 to 15.8 times more than the standard (Table IV). On average, the traps with the FA-3 synthetic lure captured 1.9 to 37 times more *C. capitata* females than the traps with only the FA-2 synthetic lure (Table V). Why the OBDT and the IPMT with FA-3 synthetic lures captured 37 times more *C. capitata* females in Yojoa and only 1.9 times more in Comayagua is unknown. The Frutect trap captured significantly fewer numbers of *C. capitata* females than the standard and is thus unfit for further research. We concluded that the FA-3 lure is more effective than the FA-2 lure and the protein attractant (NU+B). Under the conditions of this experiment, the FA-3 synthetic lure can be equally effective if used in IPMT or OBDT.

In 1997, the IPMT and a McPhail derived trap type from Spain, the Tephri trap, were tested with and without water and compared to the OBDT and to the standard IPMT, NU+B. The numbers of *C. capitata* female captured/trap/day are shown in Table VI. The comparisons between the C.capitata female daily capture between wet and dry traps are shown in Table VII. The C. capitata population density, as measured by the JT during 1997, was 378 times higher in Comayagua than in Yojoa, and 106 times higher than the highest population density recorded in previous years. In Yojoa, the population density was 13 times higher than the smallest density population registered in previous years. The addition of water under extreme dry conditions may affect the capture of *C. capitata* females, but, under the conditions of this experiment, this was not so. The addition of water to either the IPMT or the Tephri trap did not affect significatively the number of *C. capitata* females captured. (Table VII). Female *C. capitata* capture was the same, when comparing the IPMT wet trap and the Tephri wet trap to the combination of IPMT, Tephri and dry traps. Thus, we concluded that, under the conditions of this experiment, female *C. capitata* capture is the same between dry and wet traps.

Significant, but not consistent, differences were found between the treatments (Table VI). The OBDT and the IPMT, dry were the most effective treatments in Comayagua. However, the Tephri, wet, the Tephri, dry and the IPMT, dry were the most effective treatments in Yojoa. Lack of consistency in trapping efficiency among the treatments and between localities could stem from the large differences in population densities. Thus, the all-condition effectiveness of a particular trap design is unclear. All traps baited with the FA-3 synthetic lure were 0.4 to 9 times more effective than the standard treatment (Table VI). We concluded that under moderate to low *C. capitata* population densities, the most effective traps are IPMT or Tephri with the FA-3 synthetic lure.

3.2. Selectivity of the different trapping systems

The proportion of females captured in the female-targeted treatments are summarized in Table VIII. *Ceratitis capitata* female capture ranged from 43.3 % to 93.3%. However, these differences were never significant. We concluded that all female-targeted trapping systems used in this study captured the same proportion of females and thus are equally selective.

TABLE IV. MEAN ±SD FEMALE *C. capitata* CAPTURE PER TREATMENT AND BOTH SEXES MEAN ±SD CAPTURE IN JACKSON TRAP AT LAS MERCEDES, COMAYAGUA AND PEÑA BLANCA, YOJOA IN 1996

Comayagua				Yojoa			
Treatment	Daily capture [1]		Relative [2]	Treatment	Daily capture [1]		Relative [2]
IPMT, FA-3	0.354 ±0.42	a	9.8	OBDT, FA-3	0.268 ±0.53	a	15.8
OBDT, FA-3	0.282 ±0.46	a,b	7.8	IPMT, FA-3	0.229 ±0.47	a,b	13.5
IPMT, FA-2	0.204 ±0.36	b,c	5.6	IPMT, FA-2	0.075 ±0.15	b,c	4.4
OBDT, FA-2	0.139 ±0.30	c,d	3.9	OBDT, FA-2	0.057 ±0.16	c	3.4
Frutect	0.071 ±0.16	d,e	2	Frutect	0.036 ±0.14	c	2.1
IPMT, NU+B	0.036 ±0.11	e	1	IPMT, NU+B	0.017 ±0.08	c	1
F= 14.31 df= 5, 479 P < 0.0001				F= 12.07 df= 5, 475 P < 0.0001			
JT, TML	0.246 ±0.32	n/a	n/a		0.229 ±0.37	n/a	n/a

[1] Treatments followed by the same letter are not statistically different (ANOVA, Duncan's multiple range test on transformed $\log_{10}(x + 1)$ data, $\alpha = 0.05$, df = 3, 470 and 466 for Comayagua and Yojoa respectively).
[2] Relative to IPMT, NU+B which is the standard female-selective trapping system.

TABLE V. MEAN ±SD DAILY *C. capitata* FEMALE CAPTURE COMPARISONS BETWEEN TRAPS WITH FA-2 AND FA-3 SYNTHETIC ATTRACTANTS AT LAS MERCEDES, COMAYAGUA AND PEÑA BLANCA, YOJOA IN 1996

Contrast	Mean ±SD			
	Comayagua	Relative	Yojoa	Relative
IPMT, FA-3 & OBDT, FA-3	0.318 ±0.44	1.9	0.249 ±0.50	37.0
vs.	vs.		vs.	
IPMT, FA-2 & OBDT, FA-2	0.171 ±0.33	1.0	0.066 ±0.15	1.0
	I = 0.204 S = 0.156 df = 5, 473		I = 0.218 S = 0.134 df = 5, 473	

[1] Sheffe's S mean separation procedure on transformed $\log_{10}[x + 1]$ data. Linear contrast of the sum of the selected treatment means; F (0.05; 5, 473)[4].

TABLE VI. AVERAGE ±SD DAILY CAPTURE OF *C. capitata* FEMALES PER TREATMENT AND TOTAL (BOTH SEXES) *C. capitata* CAPTURE IN JT AT LAS MERCEDES, COMAYAGUA AND LA CEIBITA, YOJOA IN 1997

Comayagua				Yojoa			
Treatment	Daily capture [1]		Relative [2]	Treatment	Daily capture [1]		Relative [2]
OBDT, FA-3, dry	216 ±117	a	90	Tephri, FA-3, wet	0.70 ±1.0	a	7
IPMT, FA-3, dry	180 ±190	a,b	80	Tephri, FA-3, dry	0.57 ±1.1	a,b	5
IPMT, FA-3, wet	160 ±195	b	70	IPMT, FA-3, dry	0.57 ±1.0	a,b	5
Tephri, FA-3, wet	70 ±53	c	20	OBDT, FA-3, dry	0.40 ±0.8	b	0.4
Tephri, FA-3, dry	67 ±61	c	20	IPMT, FA-3, wet	0.11 ±0.4	c	1
IPMT, NU+B	21 ±24	d	0	IPMT, NU+B	0.00 ±0.0	c	0
F= 81.88 df= 5, 479 P < 0.0001				F= 10.22 df= 5, 479 P < 0.0001			
JT, TML	113.5 ±93	n/a	n/a	JT, TML	0.30 ±0.8	n/a	n/a

[1] Treatments followed by the same letter are not statistically different (ANOVA, Duncan's multiple range test on transformed data $\log_{10}[x + 0.1]$ and sqrt (x), $\alpha = 0.05$, df = 5, 479 for Comayagua and Yojoa respectively).
[2] Relative to IPMT, NU+B which is the standard female-selective trapping system.

TABLE VII. MEAN ±SD DAILY *C. capitata* FEMALE CAPTURE COMPARISONS BETWEEN WET AND DRY TRAPS WITH THE SAME ATTRACTANT AT LAS MERCEDES, COMAYAGUA AND LA CEIBITA, YOJOA IN 1997

Contrast	Mean ±SD	
	Comayagua	Yojoa
IPMT, wet + Tephri, wet vs. IPMT, dry + Tephri, dry	76.34 ±81.93 vs. 82.02 ±83.00	00.27 ±0.48 vs. 00.38 ±0.69
	NS	NS

[1] Sheffe's S mean separation procedure on transformed data $\log_{10}[x + 0.1]$ and sqrt(x) for Comayagua & Yojoa respectively. NS, No significant differences where observed. Linear contrast of the sum of the selected treatment means; F (0.05; 6, 473) [4].

TABLE VIII. PERCENTAGE ±SD AND RELATION-FEMALE: MALE OF *C. capitata* CAPTURE PER TREATMENT AT COMAYAGUA AND YOJOA FROM 1994 - 1997

Comayagua			Yojoa		
Treatment	% ±SD	Fem:Mal	Treatment	% ±SD	Fem:Mal
			1994		
CBDT, FA-2	53.2 ±13.0	1.1 : 1	CBDT, FA-2	86.0 ±21.9	7.00 : 1
			1995		
CBDT, FA-2	77.8 ±38.5	3.5 : 1	CBDT, FA-2	93.3 ±14.9	14.0 : 1
IPMT, NU+B	74.6 ±09.5	2.9 : 1	IPMT, NU+B	78.0 ±25.3	4.0 : 1
IPMT, FA-2	71.4 ±06.5	2.5 : 1	IPMT, FA-2	74.2 ±18.7	2.8 : 1
OBDT, FA-2	69.1 ±07.2	2.2 : 1	OBDT, FA-2	67.4 ±10.7	2.4 : 1
F = 0.18 df = 3, 17 P = 0.905	NS		F = 29.54 df = 3, 19 P = 0.129	NS	
			1996		
IPMT, FA-2	81.1 ±16.2	4.3 : 1	OBDT, FA-2	64.7 ±25.6	14.0 : 1
OBDT, FA-3	75.4 ±10.0	3.0 : 1	OBDT, FA-3	61.6 ±15.6	4.0 : 1
IPMT, FA-3	73.4 ±03.3	2.8 : 1	IPMT, FA-2	83.3 ±23.6	4.0 : 1
Frutect	73.3 ±18.1	2.7 : 1	IPMT, FA-3	78.8 ±08.8	2.8 : 1
OBDT, FA-2	59.4 ±16.5	1.5 : 1	IPMT, NU+B	82.0 ±24.9	3.5 : 1
IPMT, NU+B	43.3 ±43.5	0.8 : 1	Frutect	60.8 ±42.9	2.4 : 1
F = 1.84 df = 5, 29 P = 0.150	NS		F = 0.88 df = 5, 29 P = 0.514	NS	
			1997		
IPMT, wet	86.0 ±4.1	6.1 : 1	IPMT, wet	87.5 ±25.0	7.0 : 1
OBDT, dry	85.6 ±2.6	5.9 : 1	Tephri, dry	83.0 ±12.8	4.9 : 1
IPMT, dry	85.2 ±2.5	5.8 : 1	IPMT, dry	82.6 ±17.7	4.7 : 1
Tephri, dry	82.8 ±2.7	5.0 : 1	OBDT, dry	78.6 ±18..0	3.7 : 1
Tephri, wet	83.2 ±1.9	4.8 : 1	Tephri, wet	74.4 ±31.3	2.9 : 1
IPMT, NU+B	82.4 ±1.5	4.7 : 1	IPMT, NU+B	-----	-------
F= 2.53 df= 5, 29 P = 0.062	NS		F= 0.25 df= 4, 23 P = 0.903	NS	

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