Attractiveness of Methyl Eugenol–Baited Traps to Oriental Fruit Fly (Diptera: Tephritidae): Effects of Dosage, Placement, and Color

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Abstract. The attractiveness of methyl eugenol-baited traps to the oriental fruit fly, *Bactrocera dorsalis* (Hendel), was tested under different conditions; i.e., trap placement, color, and methyl eugenol dosage. The mean number of flies caught in hanging traps, 1–2 m above the ground (255), was not significantly different from the mean number in uncovered leaf litter traps (264), but was significantly greater than the number of flies in the covered leaf litter traps (85). Hanging and leaf litter traps interfered with each other when placed 2–3 m apart, but not when they were over 10 m apart. The mean numbers of oriental fruit flies caught in traps baited with 0, 2, 10 and 20 drops of methyl eugenol were significantly different, the numbers of flies increasing with increasing dose. In color preference studies, the mean number of flies captured in the clear traps was significantly greater than the numbers caught in the yellow, red, blue, or green traps. These results indicate that males have a strong aversion to entering shaded or dark traps. Clear traps placed in exposed sites should improve trap efficiency in both control and monitoring programs.

Keywords: *Bactrocera dorsalis*, insect behavior, nontarget species, Hawaii

Of major concern in Hawaii are species introduced both inadvertently and purposely. Introduced species not only damage native ecosystems, but many are also major agricultural pests, such as several fruit flies in the family Tephritidae. Among the latter is the oriental fruit fly, *Bactrocera dorsalis* (Hendel), which was inadvertently introduced from southeast Asia around 1945. This species attacks more than 250 species of fruits and vegetables, making it one of the most important agricultural pests in Hawaii (Hardy and Delfinado 1980; Kido 1991). Quarantine regulations prohibiting the shipment of fresh fruits from Hawaii to the U. S. Mainland were enacted to prevent the spread of fruit fly pests (Code of Federal Regulations 1988). This effectively inhibits agricultural production in Hawaii by closing potential markets.

Male annihilation is the primary control technique for the oriental fruit fly (USDA-APHIS 1985, Stark and Vargas 1992). This technique uses a mixture of methyl eugenol and an insecticide to attract and kill males resulting in a decrease in the number of mates for females and a decline in the population over time. Male annihilation could have serious environmental side effects in Hawaii (Beardsley 1991; Howarth 1991; Loope and Medeiros 1992; Asquith and Kido 1994). Oriental fruit flies are widespread in both urban areas and

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native forests (Vargas et al. 1983) making it necessary to distribute the toxicant and lure in habitats of native insects. Targeting of oriental fruit flies while reducing the number of nontarget species affected is of great importance because Hawaiian environments support a spectacular diversity of native arthropods (Howarth and Mull 1992). The present study examined the responses of oriental fruit flies and nontarget species to color and placement of traps and methyl eugenol dosage to improve control strategies.

Materials and Methods

All traps were made from clear 2-liter soda bottles by melting two entrance holes about 1.5 cm in diameter on opposite sides near the middle. Methyl eugenol was applied to a piece of cotton in the bottle cap. Approximately 75–100 ml of antifreeze (ethylene glycol) was added to the trap to kill and preserve the captured specimens. At the time of collection, the trap holes were taped to prevent spilling of the antifreeze and specimens during transport. Traps were cut in half and rinsed with water to remove specimens for identification and counting. Nontarget arthropods were stored in alcohol for identification. Voucher specimens of the significant native species are deposited in Bishop Museum.

Studies were conducted on Kapalama Ridge, Koolau Mountains, Oahu, except where noted. Kapalama Ridge is a forested area at 250–275 m elevation with many host plants of the oriental fruit fly; e.g., strawberry guava (*Psidium cattleianum*). The second study site on Poamoho Trail, Koolau Mountains, Oahu, was a forested area between 500 and 600 m elevation, wetter than Kapalama Ridge, and with many native and introduced plants including strawberry guava.

The following information was recorded for each trap site: list of dominant tree species, species of tree in which trap was hung, percent of exposed sky over trap, position of trap, distance from neighboring traps, and direction and percent of slope.

Trap Placement. At each of nine sites, one trap was hung 1–2 meters off the ground, one placed on the ground and covered with leaf litter, and one placed on the ground uncovered. The cotton was soaked with methyl eugenol, and the trapping period was January 18–30, 1993.

Dosage Response. Eight replicates of each of four treatments (0, 2, 10 and 20 drops of methyl eugenol) were used to test dosage response. The traps were placed 10–40 m apart in the following pattern: 20 drops, 10 drops, 2 drops, control, from August 20 through September 1, 1993.

Interference. To test for interference, the trap placement study was expanded to include 20 sites each 30 m apart. For the first week, from February 27 to March 6, 1993, each site had only one leaf litter trap. Alternate traps were covered with large pieces of bark or sticks and leaf liter. On March 6, flies were counted, and the traps returned to the same site. At this time a hanging trap was placed at each site and additional covered leaf litter traps were placed in 5 new sites as controls. On March 13, 1993, all traps were collected. All traps were baited with 2 drops of methyl eugenol.

Color Preference—Kapalama Ridge. Traps were spray painted red (Krylon Radiant Red 9210), green (Krylon Forest Green 9215), and blue (Krylon Dolphin Blue 9214 and Dutch Boy FE-506 Blue). The traps baited with 20 drops of methyl eugenol were set out on January 15, 1995, at eight sites and collected on January 28, 1995. Four traps (clear, red, green and blue) were hung equidistant around each 5 m diameter site.

Color Preference—Poamoho. Low population levels of the oriental fruit fly on Kapalama Ridge prompted a move to Poamoho for the second color preference experiment. At each of ten sites along Poamoho Trail four traps (clear, yellow [Krylon Sunflower yellow 9211], red and blue) baited with 30 drops of methyl eugenol were set out from March 4 to March

18,1995.

The amount of light entering each trap was determined by placing the cut bottom half of the trap over the lens on a 35 mm camera. When the camera with the trap bottom was aimed at the clear blue sky, the f-stop reading of the light meter provided a consistent relative measure of light intensity inside the trap. The median f-stop value for the different traps was as follows: ambient light and clear traps = 32; yellow = 12.2; red = 5.2; and blue = 3.725.

Statistical Analysis

In many of the experiments, the number of arthropods caught in a trap varied with the site (i.e. if one trap had a large number of oriental fruit flies, the other traps in that site most likely did also). To correct for the high variability among sites, one of each trap type to be tested was placed at each site. This allowed the use of the Two-tailed Wilcoxon Matched-Pairs Signed-Rank Test (Runyon and Haber 1984) to compare each site individually in testing for significant differences in variables ($P<0.10$). The Student *t*-test ($P<0.05$) was also used when applicable.

Results

Trap Placement. The mean number of oriental fruit flies caught in hanging traps (255) was not significantly different than the mean number in uncovered traps placed on the ground (264) (Table 1). The shaded leaf litter traps caught significantly fewer fruit flies (85) than either the hanging or the uncovered leaf litter traps.

A total of 1865 non-target arthropods and 11 alien slugs were caught. The most abundant identifiable species were the aliens *Drosophila suzukii* (138) and the longlegged ant, *Anoplolepis longipes* (1568). Because no unbaited traps were used, it is unknown whether any species was attracted to methyl eugenol.

Dosage Response. The mean numbers of oriental fruit flies caught in traps baited with 0, 2, 10, and 20 drops of methyl eugenol were significantly different, the numbers of flies increasing with increasing dose (Wilcoxon matched pairs signed-rank test) (Figure 1).

A total of 1764 non-target arthropods were captured including 1403 long-legged ants, 93 native midges (*Forcipomyia hardyi*), 3 alien *Drosophila suzukii,* and 1 native moth (*Mestolobes* sp.). The amount of methyl eugenol did not appear to have any effect on the number of non-targets per trap.

Interference. Each site that had an uncovered leaf litter and hanging trap less than 2 m apart (with two drops of methyl eugenol each) caught approximately the same number of flies per day as would be expected in one hanging trap with four drops of methyl eugenol (Figure 1). The number of flies caught per day (15) in the uncovered leaf litter traps when no hanging trap was present was not different from the number of flies caught in traps with 2 drops of methyl eugenol (16) in the dosage response study. The number of flies caught in uncovered leaf litter traps with the hanging trap present was 87% of the number caught when no hanging trap was present (Table 2).

The interference test also corroborated the results obtained in the trap placement study. Significantly more oriental fruit flies were collected in the uncovered leaf litter traps than in the covered leaf litter traps (Table 2). The difference may be related to the amount of sunlight hitting the traps as indicated when the trap catches are compared to the amount of sunlight (Figure 2). The amount of sunlight, estimated from the amount of shade created by the canopy, was 50–70% at sites 8, 10, and 13 where the adjacent traps caught the most flies. At sites 3, 5, 11, and 18, where the percent sunlight was minimal, the traps caught the fewest flies. However, because of the high variance among sites, no statistical significance was found between the amount of sunlight and the mean number of flies caught.

Table 1. Numbers of oriental fruit flies caught in traps baited with methyl eugenol and left out from January 15 to 28, 1993, Kapalama Ridge, Oahu.

	Trap type		
	Hanging	Leaf litter	
Site		Covered	Uncovered
1	520	37	192
2	148	127	504
3	332	76	370
4	193	83	164
5	178	27	368
6	181	194	188
7	157	53	232
8	413	33	249
9	173	136	111
Mean (S.D.)	255 (127) a	85 (53) b	264 (118) a

Means followed by the same letter were not significantly different (P > 0.05; student's *t*-test) a and b significantly different (P < 0.005).

Figure 1. Mean numbers of oriental fruit flies captured per day in clear plastic traps baited with different amounts of methyl eugenol. Eight replicates of treatments 0, 2,10, and 20 drops of methyl eugenol were set out from August 20 to September 1, 1993, and 10 pairs of clear traps with 2 drops of methyl eugenol each set out from Febuary 27 to March 6, 1993. All on Kapalama Ridge, Oahu. (Mean ± SEM).

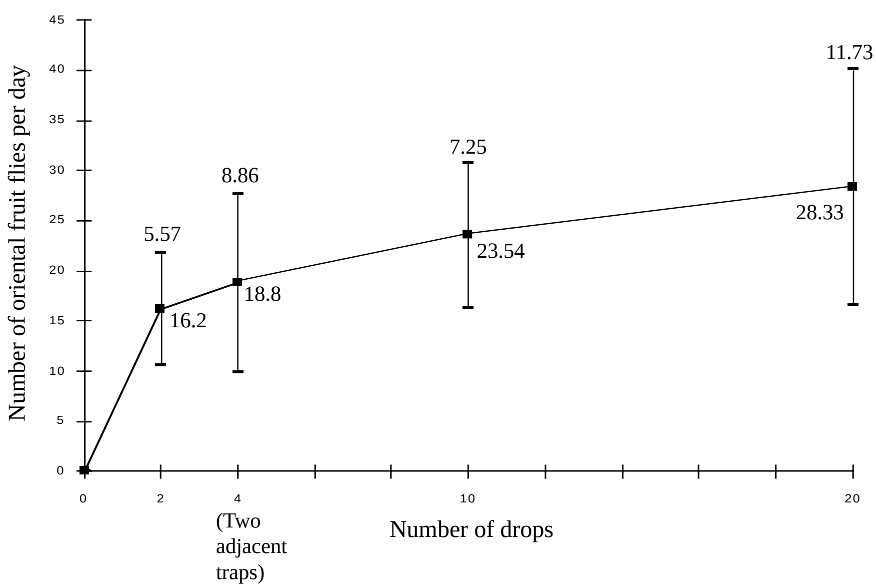


Table 2 a and b: Numbers of oriental fruit flies caught on Kapalama Ridge, Oahu; (a) in hanging and leaf litter traps left out from February 27 to March 6, 1993; (b) in covered, uncovered, and hanging traps left out from March 6 to 13, 1993.

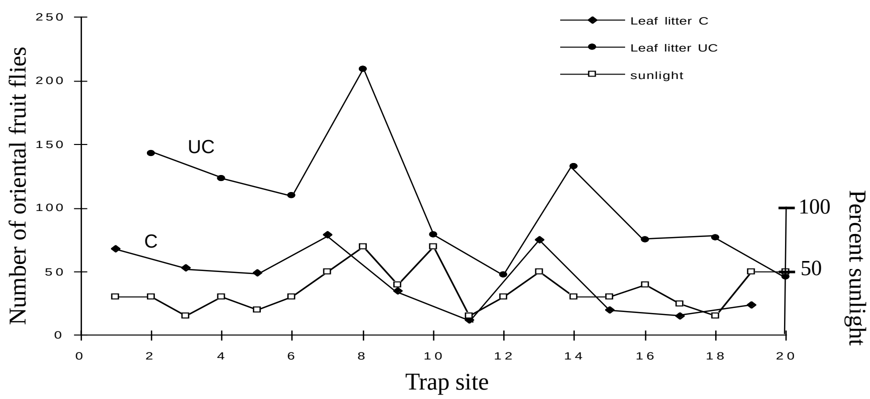
	(a)				(b)		
	Covered	**Uncovered**	**Catch ratio**		**Hanging**	**Covered**	**Uncovered**
Site			**Covered**	**Uncovered**			
1	68				45	25	
2		143		2.4	28		40
3	53		0.4		17	58	
4		123		2.4	40		130
5	49		0.4		50	19	
6		110		1.7	40		49
7	79		0.5		71	94	
8		209		1.8	46		183
9	35		0.2		39	43	
10		79		3.4	28		84
11	12		0.2		60	47	
12		48		1.1	43		102
13	75		0.8		45	101	
14		133		2.8	125		80
15	20		0.2		46	71	
16		75		4.3	23		spilled
17	15		0.2		18	30	
18		77		3.9	30		spilled
19	24		0.4		38	22	
20		46			32		63
Mean (S.D.)							
	43 a	104.3 b	0.4 c	2.6 d	41 a	51 a	91 b
	(24)	(47.4)	(0.2)	(1)	(25)	(28)	(43)

Means followed by the same letter were not significantly different by the Student *t*-test, P>0.05.

Correction for site differences along the transect was made by comparing each trap catch with the mean number of flies caught in the neighboring traps (Table 2a). The formula used was catch ratio = trap catch/(sum of neighboring trap catches X 0.5). In every case the catch ratio of the covered traps was <1 and uncovered traps >1.1 [P<0.0002 (Student *t*-test)].

Color Preference—Kapalama Ridge. The number of flies caught in the clear traps was significantly greater than the number caught in the traps of each color (P<.02). However, the numbers of flies caught in the red, green, and blue were not significantly different from each other (Table 3). There was a correlation between sites and numbers of flies captured. Most flies were caught at the sunnier sites (1, 2, 3, 6, 7 and 8), and the lowest numbers were caught at the more shaded sites (4 and 5). Fewer of flies were collected in 1995 than in 1994 or 1993.

Figure 2. Numbers of oriental fruit flies caught in covered and uncovered leaf litter traps baited with methyl eugenol and set out from January 18–30, 1993, on Kapalama Ridge, Oahu, in relation to the amount of sunlight.



Large numbers of longlegged ants came to the traps; the rank order of the different colors was clear>red>green>blue (Table 4). The number coming to clear traps was only significantly different from the numbers coming to the green and blue traps. Significantly more ants were captured in the red traps than in the blue traps. More species of nontarget arthropods were captured in the clear traps than red traps. The numbers of species coming to the clear, green, and blue traps were not significantly different from each other (Table 4).

Color Preference—Poamoho. The highest number of oriental fruit flies were caught in the clear traps, then yellow, blue and red (Table 3). The numbers of flies captured by traps of one color were significantly different from the numbers caught in the other colored traps (Two-tailed Wilcoxon Signed-Rank Matched Pairs Test). The level of significance between the clear and red, clear and blue, yellow and red, and yellow and blue was high ($P<0.005$). A total of 435 specimens of nontarget arthropods, representing 47 species, were captured in the traps. The clear traps captured significantly greater numbers of nontarget arthropods, both individuals (230) and species (31), than the colored traps. The yellow traps captured significantly more species (25) than either the red (17) or the blue (15) and a greater number of specimens (84) than the blue (48). The numbers of individuals captured in the yellow (84) and red traps (73) were not significantly different (Table 5).

Four nontarget species were captured in significantly greater numbers in the clear traps compared to the colored traps. These were an unidentified species of jumping spider (Salticidae), an endemic Hawaiian fungus beetle (Corylophidae, *Sericoderus pubipennis*), the nonnative vinegar fly (Drosophilidae, *Drosophila suzukii*), and an endemic species of vinegar fly (*Scaptomyza* sp.) (Table 5).

Table 3: Numbers of oriental fruit flies caught in traps baited with methyl eugenol and left out from January 15–28, 1995, on Kapalama Ridge, Oahu and March 4–18, 1995 on Poamoho Trail Oahu, respectively.

	Trap color			
Site	**Clear**	**Red**	**Green**	**Blue**
Kapalama Ridge				
1	43	17	26	17
2	22	22	9	15
3	19	5	16	17
4	9	4	5	0
5	7	3	3	7
6	15	7	4	8
7	19	1	3	8
8	13	4	14	8
Mean(S.D.)	18.38 (11.2) a	7.88 (7.49) b	10 (8.18) b	10 (5.9) b
	Clear	**Red**	**Green**	**Blue**
Poamoho				
1	382	205	191	190
2	264	70	143	153
3	131	58	187	92
4	303	196	238	133
5	230	109	189	136
6	178	20	163	98
7	293	111	228	152
8	208	220	260	230
9	217	55	189	75
10	194	70	112	108
Mean(S.D.)	240 (72.3) a	111.4 (71.1) b	190 (44.3) c	136.7 (47.4) d

Means within each row followed by the same letter are not significantly different ($P>0.1$). Totals followed by a different letter were significantly different ($P<0.1$). Wilcoxon Matched-Pairs Signed Rank Test.

Discussion

Fewer oriental fruit flies entered covered leaf litter traps than entered uncovered leaf litter traps and hanging traps. The number of oriental fruit flies caught increased with the amount of sunlight in the area, though no statistically significant difference was found. This factor should be studied further. In addition, colored traps allowing the most light to enter (yellow and clear) caught the most flies in the color preference study. Our data indicate that male oriental fruit flies avoid shaded or darkened areas; therefore, male annihilation programs may be less effective if the control mixture falls into shaded situations or becomes covered.

The oriental fruit fly exhibits a preference for color as well as light intensity. In the Poamoho study, more oriental fruit flies came to blue traps than to red traps even though more light was transferred through the red traps. Stark and Vargas (1992) also found orien-

Table 4: Nontarget animals captured in clear, red, green, and blue traps baited with methyl eugenol and left out from January 15 to 28, 1995, on Kapalama Ridge, Oahu.

Order, etc.	Family, etc.	Name	Total	Clear	Red	Green	Blue
Amphipoda	Talitridae	landhoppers	2	0	1	1	0
Arachnida	Acari	mites 3 spp.	4	0	0	2	2
Arachnida	Araneae	spiders 2 spp.	2	1	0	0	1
Blattaria	*Balta* sp.	cockroach	1	0	0	0	1
Collembola	unidentified	springtails	5	1	0	2	2
Colleoptera	Ptiliidae ?	featherwing beetles	9	5	2	2	0
Colleoptera	Scolytidae	bark beetles	8	3	2	2	1
Diptera	*Forcipomyia hardyi*	biting midges	13	1	1	8	3
Diptera	Phoridae	coffin flies	1	0	0	1	0
Diptera	Sciaridae	black fungus gnats	1	0	0	1	0
Diptera	Drosophilidae	drosophila fly	1	1	0	0	0
Diptera	Unidentified flies	flies 3 spp.	4	2	1	1	0
Homoptera	Aphididae	aphids	1	1	0	0	0
Hymenoptera	Agaonidae	fig wasps	4	1	0	0	3
Hymenoptera	Bethylidae	parasitic wasp	2	1	1	0	0
Hymenoptera	Braconidae	parasitic wasp	1	0	0	1	0
Hymenoptera	Chalcidoidea	parasitic wasps	3	1	0	1	1
Hymenoptera	Proctotrupoidea	parasitic wasp	3	3	0	0	0
*Hymenoptera	Formicidae	long-legged ants	462	201 a	144 ab	65 bc	52 c
Hymenoptera	Formicidae	unidentified ants	3	2	0	0	1
Lepidoptera	Alucitidae	*Alucita objurgatella*	2	0	0	2	0
Lepidoptera	Crambidae	*Mestolobes* moth	8	5	1	1	1
Lepidoptera	Tineidae	clothes moths	3	2	0	1	0
Psocoptera	unidentified	bark lice 3+ spp.	11	2	4	3	2
Thysanoptera	unidentified	thrips	3	1	1	1	0
Mollusca	Pulmonata	snails	3	1	1	0	1
Total species			33	20 a	11 b	18 ab	14 ab

Totals within rows followed by the same letter are not significantly different (P>0.1) by the Wilcoxon Matched-Pairs Signed Rank Test.

tal fruit flies tended to enter blue traps more than red. They also found white and yellow traps were more attractive than darker colored traps and suggested that attractiveness was correlated with the intensity of reflectance of the trap in the visible spectrum rather than with the hue. They did not test clear traps, however. Preference for yellow may be due to both light intensity and the fact that yellow and white flowers are natural sources of methyl eugenol (Stark and Vargas 1992). Chua (1993) found yellow and green sticky traps to catch more *Bactrocera* Malaysian A and B than red sticky traps.

We did not do a strict choice color response test because our earlier study indicated that traps placed close together interfered with each other. Also we wanted to test a trap deployment scheme closer to normal monitoring strategy in which individual traps would be well separated. Our results indicate that some male flies will forego entering a baited trap if visual cues are repellent.

The dosage response test demonstrated that the higher the concentration of methyl eugenol in the trap, the greater the number of fruit flies caught. The methyl eugenol level approached maximum attractiveness at 20 drops (ca. 1 ml), but this point needs further study. In the trap placement studies, a significantly higher number of fruit flies came to the traps per day than in the interference studies. The amount of lure used may explain the difference because in the trap placement studies, the cotton was soaked with methyl eugenol (i.e., >20 drops), whereas in the interference studies only two drops of methyl eugenol were used.

There was interference between traps placed less than 2–3 m apart, but not for traps separated by more than 10 m. Two closely placed traps, each with two drops of methyl eugenol, had a combined total number of flies equal to that expected for one trap with 4 drops, but much less than expected for two separated traps each with two drops (Figure 2). This indicated that the same number of flies were attracted to the site, after which they appeared to go to one trap or the other. In contrast to our earlier trap placement study, more flies entered the uncovered leaf litter traps than entered the neighboring hanging traps during the second week of the interference study (Table 2). Possibly, traps with already caught flies are more attractive than empty baited traps.

Color preference studies on Kapalama Ridge indicated that the population of oriental fruit flies was lower than in past years. Catches in comparable traps were 1.4 flies per clear trap per day in January 1995, and 28.3 flies per clear trap per day at the same site in August 1993, a 20-fold difference. In January, 1993, with a similar amount of lure, 20 flies were captured per trap per day. The low catch in 1995 may have been due to a drought and a reduction in the abundance of hosts, especially strawberry guava fruits. Poamoho, a much wetter area, had a higher catch (17.1 flies per day in the clear trap) than Kapalama (1.4 flies per day in the clear trap). The small sample sizes on Kapalama Ridge may explain why no significant difference was found between the numbers caught in the red, green and blue traps.

Many nontarget arthropods were captured in these studies. Nonbaited control traps were present only in the dosage response studies. However, in the latter study no nontarget species appeared to be attracted to methyl eugenol. These results are limited because the study site on Kapalama Ridge is in a disturbed forest with few native species present. More native arthropod species occur at the Poamoho site than at the Kapalama site, and some of the species listed in Table 5 that came in numbers may be attracted to methyl eugenol. For example Asquith and Kido (1994) found seven species of native drosophilids, two species of native muscids, and one species of native phorid were attracted to methyl eugenol on Kauai. In addition, they found a few other species for which the evidence of attraction was equivocal. However, no species was more strongly attracted than in proportion to its local abundance, suggesting that mitigation in control programs is possible, at least on Kauai.

In the color preference studies more nontarget arthropods were caught in clear and yellow traps than in the blue, green, or red traps. The greater numbers of species and individuals of nontargets captured in the yellow compared to red and blue traps were expected because yellow is known to be attractive to many insects (Prokopy and Owens 1983). However, the greater number captured in the clear traps than the yellow was surprising. Nontarget species may be reluctant to enter a shaded or dark trap. Also some predators may have been attracted to dead or dying flies which they could see only through the clear traps. One surprising result was that more long-legged ants were collected in clear and red traps than in green and blue traps. This could be because the ants were avoiding the blue and green traps for behavioral reasons or because in these traps the ants could find and escape through the holes.

Table 5: Nontarget animals captured in clear, yellow, red and blue traps baitedwith methyl eugenol and left out from March 4–18, 1995, on Poamoho Trail, Oahu.

		Clear	Yellow	Red	Blue
ARACHNIDA					
ACARI	Galumnidae	1	0	0	0
ARANEAE	Salticidae sp. A	12 a	2 b	3 b	1 b
	Salticidae sp. B	0	1	0	0
	Theridiidae *Argyrodes* sp.	0	5	2	2
	Theridiidae *Theridion* sp.	0	0	0	1
	Thomisidae sp. A	0	1	0	0
	Thomisidae sp. B	0	1	0	0
	Thomisidae sp. C	0	0	0	1
	unidentified spiderlings	0	2	0	0
INSECTA					
COLLEMBOLA	unidentified sp.	0	0	9	0
ORTHOPTERA	Gryllidae *Leptogryllus* sp.	1	0	0	0
	unidentified cricket	1	0	0	0
BLATTARIA	Blattellidae *Balta* sp.	1	1	0	0
PSOCOPTERA	unidentified sp.	6	1	1	1
HETEROPTERA	Nabidae *Nabis lusciosus*	8	5	0	0
HOMOPTERA	Coccidae	0	1	0	0
	Delphacidae	1	0	0	0
	Psyllidae	3	2	2	0
COLEOPTERA	Bostrichidae	1	0	0	0
	Corylophidae, *Sericoderus pubipennis*	55 a	1 b	1 b	0 b
	Nitidulidae sp. A	5	0	1	0
	Nitidulidae sp. B	1	0	0	0
	Nitidulidae sp. C	0	0	1	0
	Staphylinidae	0	0	1	0
LEPIDOPTERA	Alucitidae, *Alucita objurgatella*	1	2	0	0
	Gelechiidae	0	1	1	0
	Tineidae *Opogona* sp.	1	0	0	0
	Tineidae sp. A	15	7	6	2
	Tineidae sp. B	0	1	0	1

Nishida and Vargas (1990) found that there was tree to tree variation in abundance of oriental fruit flies, even among trees of the same species. We also observed this in our studies, as indicated by the high standard deviation in mean numbers of flies per site. However, within each site if one trap had high numbers, the others did also. The amount of sunlight at each site appeared to be the major factor explaining this observation.

Control programs, in which pieces of absorbent composition board impregnated with methyl eugenol and insecticide are dropped into Hawaiian forests may be problematic. We

Table 5 (continued).

		Clear	Yellow	Red	Blue
INSECTA (continued)					
DIPTERA	Calliphoridae	1	0	0	0
	Cecidomyiidae	0	0	0	1
	Ceratopogonidae, *Forcipormyla* spp.	26	27	36	30
	Drosophilidae,				
	Drosophila suzukii	35 a	6 b	3 b	3 b
	Scaptomyza sp.	15 a	1 b	0 b	0 b
	other Drosophilidae	5	0	0	1
	Muscidae *Atherigona* sp.	6	1	0	0
	Neriidae, *Telostylinus lineolatus*	5	0	0	0
	Phoridae	5	1	0	0
	Psychodidae *Psychoda* spp.	1	9	1	0
	Sciaridae	3	3	0	1
	Tipulidae *Limonia* sp.	0	0	2	1
	Chironomidae	0	0	0	1
HYMENOPTERA	Chalcidoidea sp. A	0	0	2	0
	Chalcidoidea sp. B	4	0	0	0
	Chalcidoidea sp. C	8	0	0	0
	Mymaridae	1	1	0	0
	Formicidae	1	1	1	1
MOLLUSCA	slug	1	0	0	0
TOTALS	*species	31 a	25 b	17 c	15 c
	*specimens	230 a	84 b	73 bc	48 c

*Within each row totals followed by the same letter were not significantly different ($P>0.1$). Totals followed by a different letter were significantly different ($P<0.1$). Wilcoxon Matched-Pairs Signed Rank Test.

agree with Asquith and Kido (1994) that placing the lure and toxicant in the canopy will be more effective in controlling fly populations. Our data further suggest that attractants placed closer than 10 m apart will interfere with each other and would be less cost efficient. In monitoring oriental fruit fly populations, placement of clear traps in open sunny areas will maximize the chance of detection.

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