TABLE 4.—The droplet size of MALATHION LV Concentrate insecticide produced with the Beecomist 10μ, 20μ and 40μ spray heads, using needle valve settings 3, 4 and 5.

	10μ sleeve			20μ sleeve			40μ sleeve		
Needle valve setting	MMD (μ)	Average diameter (μ)	Maximum diameter (μ)	MMD (μ)	Average diameter (μ)	Maximum diameter (μ)	MMD (μ)	Average diameter (μ)	Maximum diameter (μ)
3	17	20	66	61	47	97	28	30	88
4	14	17	60	28	31	97	29	30	91
5	14	17	54	27	28	94	26	27	94

In determining the droplet sizes, needle valve settings 3, 4 and 5 were tested because (1) high flow rates were obtained (Table 2), and (2) the number of droplets per cm^2 (in^2) was greater at these settings (Table 3).

The smallest droplet measured using the 10μ sleeve was 6μ, while the smallest droplets with the 20μ and 40μ sleeves measured 11μ.

CONCLUSION. Aside from refining the mechanical operations, the next step is to relate these data to residual efficacy.

The Beecomist ULV hand applicator is being developed primarily as a tool for applying LVC residual insecticides in malaria eradication and control programs. The data presented here are preliminary, but they do indicate that the potential uses of this unit are many, and that it could be adapted for other insect vector control programs.

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THE SUSCEPTIBILITY OF MOSQUITO LARVAE TO INSECTICIDES IN FLORIDA, 1969–1971

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Since 1964 mosquito larvae from different areas of Florida have been tested for their susceptibility to various insecticides in order to determine any possible resistance build-up. Previous papers dealt mainly with two-year comparative results, while this paper covers the period 1969–1971.

METHODS. The methods for mosquito collection, shipments, and larval testing were essentially the same as described by Rathburn and Boike (1967) and Boike and Rathburn (1969). Since water temperature and kind of testing vessel were found to be important factors affecting test results (Rathburn and Boike, 1969),

all tests were performed using 400 ml. polypropylene beakers and, except where noted, suspended in a water bath at 80° F.

All insecticides were diluted in acetone with the exception of malathion for 1969 which was diluted in 95 percent ethyl alcohol. In order to have a standard diluent for all insecticides, malathion dilutions in alcohol were compared with acetone dilutions in paired tests using larvae from laboratory colonies of *Aedes taeniorhynchus* (Wiedemann) and *Culex nigripalpus* Theob.

RESULTS AND DISCUSSION. The lethal concentrations (in p.p.m.) for several mosquito species from several areas tested against malathion, naled, fenthion, and Abate are shown in Table 1. From the areas sampled there appears to be little variation in susceptibility of the different

TABLE 1.—Susceptibility of mosquito larvae from various areas of Florida to several insecticides, 1969–1971.

Mosquito species	County	Area	Year	Reps.	Lethal concentration in ppm. LC_{50}	LC_{90}
		malathion				
Aedes taeniorhynchus	Lab. colony	Panama City	1969[a]	10	0.020	0.034
	Lab. colony	Panama City	1970	3	0.028	0.042
	Brevard	Merritt Is.	1970	8	0.140	(1.350)
	Lee	Sanibel Is.	1969[a, b]	8	0.067	(0.400)
	Lee	Sanibel Is.	1971	28	0.039	0.195
	Lee	Pine Is.	1969[a, b]	4	0.054	(0.126)
Aedes sollicitans	Hillsborough	Big Bend	1969[a]	4	0.030	0.051
	Lee	Little Pine Is.	1969[a, b]	4	0.035	0.055
Culex nigripalpus	Lab. colony	Panama City	1969[a]	26	0.031	0.041
	Lab. colony	Panama City	1970	16	0.038	0.052
	Brevard	Mims	1969[a]	8	0.046	0.063
	Pinellas	Lake Maggiore	1971	8	0.051	0.077
Culex restuans	Bay	Lynn Haven	1969[a]	4	0.030	0.048
Culex salinarius	Bay	State Park	1969[a]	8	0.042	0.063
	Bay	Tyndall AFB	1970[a]	16	0.062	0.093
	Bay	Tyndall AFB	1971	16	0.060	0.088
	Pinellas	Lake Maggiore	1971	7	0.047	0.074
		naled				
Aedes taeniorhynchus	Lab. colony	Panama City	1970	8	0.077	0.154
Aedes sollicitans	Hillsborough	Big Bend	1969	10	0.096	0.128
Culex nigripalpus	Lab. colony	Panama City	1969	16	0.069	0.087
	Lab. colony	Panama City	1970	8	0.050	0.084
	Brevard	Mims	1969	8	0.079	0.110
	Pinellas	Lake Maggiore	1971	8	0.072	0.090
Culex salinarius	Bay	Tyndall AFB	1971	8	0.075	0.097
	Pinellas	Lake Maggiore	1971	11	0.070	0.109
		fenthion				
Aedes taeniorhynchus	Lab. colony	Panama City	1970	8	0.00084	0.00125
Culex nigripalpus	Lab. colony	Panama City	1970	24	0.00330	0.00440
Culex salinarius	Bay	State Park	1969[b]	7	0.00240	0.00330
	Bay	Woodlawn	1969[b]	7	0.00235	0.00310
		Abate				
Culex salinarius	Bay	Woodlawn	1969[b]	4	0.00058	0.00091

[a] Diluent is alcohol.
[b] Not tested in water bath.
Figures in parentheses are extrapolated values.

species to the various insecticides. An exception is the LC_{50} of malathion obtained with *A. taeniorhynchus* from Merritt Island in Brevard County which is five times higher than with the laboratory colony. Larvae of *Culex nigripalpus* and *Culex salinarius* from Lake Maggiore in Pinellas County, however, showed little variation in susceptibility to malathion or naled compared to figures obtained during previous years, (Rathburn and Boike, 1967 and Boike and Rathburn, 1969). In 1966 the LC_{50} and LC_{90} values for *C. nigripalpus* from Lake Maggiore tested against malathion were 0.038 and 0.058 respectively while in 1971 the values were 0.051 and 0.077, indicating little change over a 5-year period. Similarly, when larvae of *C. nigripalpus* from Lake Maggiore were tested against naled in 1966, the LC_{50} and LC_{90} figures were 0.068 and 0.090 respectively as compared to 0.072 and 0.090 obtained in 1971.

In comparing the difference between alcohol and acetone as diluents for malathion (Table 2) no difference could be detected for *A. taeniorhynchus*. When comparisons were made with *C. nigripalpus*, acetone gave slightly higher LC_{50} and LC_{90} figures than alcohol. However, for practical purposes no significant differences could be found.

Since first sampled in 1965, *Aedes taeniorhynchus* from Brevard and Lee Counties have shown variable degrees of susceptibility to malathion when compared to the laboratory colony, as shown in Table 3. The data from Lee County for 1969 and 1971 further substantiate a trend stated by Boike and Rathburn (1969) that the decrease in usage of malathion in that area was reflected in lower LC_{50} and LC_{90} values. Although no figures were available on the amount of malathion dispersed during 1969–1971, the LC_{50} and LC_{90} values for *A. taeniorhynchus* from Sanibel and Captiva Islands of 0.039 and 0.195 for 1971 are considerably lower than those of 1965.

In Brevard County no increase in susceptibility of *A. taeniorhynchus* from Merritt Island was noted from 1965 to 1970. However, little difference could be detected in 1969 when *C. nigripalpus* from Mims was tested against malathion and naled as compared to the susceptible laboratory colony. Recently Mount, *et al.* (1971) reported a strain of *A. taeniorhynchus* from Allenhurst as having an LC_{50} of 0.88 ppm of malathion. The LC_{50} shown for Allenhurst in Table 3 is considerably lower than that reported by Mount from this area; however, the LC_{50} for malathion in Table 3 was obtained with *A. sollicitans* which may account for the apparent difference. A similar difference is also evident between the data obtained from Merritt Island in 1968 where 50 percent of the larvae tested were *A. sollicitans* and in 1965 and 1970 where the larvae tested were all *A. taeniorhynchus*. Although no tests were performed recently against *A. taeniorhynchus* from the northern part of Brevard County, it is highly probable that local populations may still show resistance to malathion.

SUMMARY. Larvae of *C. nigripalpus* and *C. salinarius* from Brevard, Bay and Pinellas Counties collected during 1969–1971 showed little variation in suscepti-

TABLE 2.—Comparison of acetone and alcohol used as diluent in susceptibility tests of *Aedes taeniorhynchus* and *Culex nigripalpus* larvae to malathion (1969).

Mosquito species	Diluent	Reps.	Lethal concentration in ppm. LC_{50}	LC_{90}
Culex nigripalpus	alcohol	20	0.034	0.045
	acetone	20	0.043	0.063
Aedes taeniorhynchus	alcohol	7	0.015	0.030
	acetone	7	0.016	0.029

TABLE 3.—Susceptibility of *Aedes taeniorhynchus* larvae to malathion in Brevard and Lee County, Florida.

County	Area	Year	Lethal concentration in ppm. LC_{50}	LC_{90}
Brevard	Mims	1965	0.100	0.780
	Allenhurst	1966	0.042[a]	0.086
	Titusville Beach	1966	0.075	0.124
	South Brevard Co.	1966	0.080	1.500
	Merritt Island	1965	0.180	0.460
	Merritt Island	1968	0.076[b]	0.250
	Merritt Island	1970	0.140	(1.350)
Lee	Sanibel-Capt. Island	1965	0.457	3.400
	Sanibel-Capt. Island	1966	0.220	2.600
	Sanibel-Capt. Island	1967	0.086	0.280
	Sanibel-Capt. Island	1969	0.067	(0.400)
	Sanibel-Capt. Island	1971	0.039	0.195
	Bonita Beach	1965	0.275	1.500
	Bonita Beach	1966	0.105	1.050
	Bonita Beach	1968	0.072	0.280
Lab. Colony	Panama City	1965	0.029	0.062
		1966	0.025	0.050
		1967	0.030	0.047
		1968	0.021	0.037
		1969	0.020	0.034
		1970	0.028	0.042

[a] *Aedes sollicitans.*
[b] Mixed population—approx. 50%. *A. taeniorhynchus,* 50% *A. sollicitans.*
Figures in parentheses are extrapolated values.

bility to malathion, naled or fenthion when compared to the laboratory colony and data of previous years. Larvae of *A. taeniorhynchus* from Merritt Island in Brevard County collected in 1970 still showed a 5-fold decrease in susceptibility to malathion when compared to the laboratory colony, while those collected from Sanibel and Captiva Islands in Lee County showed a 10-fold increase in susceptibility since 1965. The Panama City laboratory colony of *A. taeniorhynchus* showed little variation in susceptibility to malathion from 1965 to 1970.

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