Representatives of all larval instars of *Aedes aegypti* reared from eggs held at constant temperatures were used to determine the efficacy of hydrogen peroxide as a larvicide. Eggs of this species were obtained from a rearing colony located at the Gulf Coast Mosquito Laboratory (USDA, SEA-AR) at Lake Charles, Louisiana. Tests were conducted at the Southern Weed Science Laboratory (Stoneville Research Quarantine Facility), Stoneville, MS 38776.

Bioassays were conducted under controlled conditions with larvae confined to 250 ml glass beakers which served as exposure containers. Each replicate was filled to 200 ml with the various concentrations of hydrogen peroxide-aerated tap water solutions. Ten larvae were introduced into each of 7 replicates per concentration and held for continous exposure. Mortalities were taken at 24 hr intervals, and dead larvae were removed daily. Control replicates were of the same containers and number with aerated tap water as the exposure medium. All replicates received grated animal food at 48 hr intervals throughout the test period(s).

Mortality data for these tests showed ranges of acceptability at dosages beginning at 3.2 mM and increased as the concentrations increased. Values at the end of the 168 hr test period for all stages and in all concentrations of 3.2 mM or higher were 60% or higher (Table 1).

While such a technique is not deemed economically feasible for wide range mosquito control, it could have potential for use in industrial impoundments or similar situations.

Table 1. Larvicidal properties of hydrogen peroxide on larvae of *Aedes aegypti* under controlled laboratory conditions.

Concentration mM	Percent mortality/time period (hrs.) 24	48	72	96	120	144	168
	First and Second Instars						
Control	0.0	4.3	4.3	5.7	5.7	5.7	5.7
3.2	34.3	45.7	54.3	64.3	64.3	67.1	67.1
4.8	60.0	65.7	68.6	80.0	80.0	81.4	81.4
6.4	62.8	68.6	81.4	91.4	92.8	97.1	97.1
	Third and Fourth Instars						
Control	0.0	0.0	0.0	1.4	1.4	1.4	1.4
3.2	8.5	21.4	28.5	42.8	48.5	54.2	60.0
4.8	17.1	38.5	40.0	60.0	70.0	77.1	78.5
6.4	28.5	58.5	68.5	75.7	81.4	88.5	90.0

These data are offered as a supplement to the use of hydrogen peroxide in an integrated management program for aquatic weeds and its effect(s) on non-target organisms.

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NATIVE AND EXPERIMENTAL REPELLENTS AGAINST BLACK FLIES (DIPTERA: SIMULIIDAE) IN THE AMAZON BASIN OF BRAZIL

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A plethora of medical problems is attributable to black flies in the Amazon Basin. Certain flies have been incriminated as vectors of *Onchocerca volvulus* (Rassi et al. 1975, Shelley et al. 1979) and *Mansonella ozzardi* (Cerqueira 1959, Shelley and Shelley 1976) and are believed to be responsible for mortality in humans as a direct consequence of allergic reactions to their bites (Noble et al. 1974, Pinheiro et al. 1974). In addition, their pestiferousness may seriously deter residents of the interior from productivity and leisure (Lacey in press, Lacey and Charlwood 1980).

Due to the enormous volume of water passing through the major larval breeding sites, larvicidal control, except under certain conditions, would not be practical in most of the basin. One method of reducing biting activity is

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by wearing protective clothing and utilizing repellents. Investigations by Schmidt (1977) and Schreck et al. (1979) demonstrate that certain experimental repellents provide lasting protection against some species.

Most long-term residents of the interior are remarkably tolerant to the bites of black flies. At certain times of the year, however, when simuliid populations are at peak levels, residents often utilize indigenous means for providing relief against excessive bites. One method is the use of smoke. The individual shown in Fig. 1 places embers and wood chips in a home-made smoker for limited protection against "piuns and borrachudos" (*Simulium sanguineum* s.l. Knab and *Simulium guianense* Wise) along the Tapajós River in the Amazon National Park.

Fig. 1. Homemade smoker offers limited protection from black fly attack.

Some residents of the park use the oil obtained from boiling the fruit of Copaíba (*Copaifera* (L.) spp.:Caesalpiniaceae) as a repellent. Copaíba oil is also commonly mixed with pulp of the Jatobá fruit (*Hymenaea*). In the northern Amazon Basin of Brazil the Yanomama Indians also utilize Copaíba oil and Urucú (*Bixa orellana* L.) as a repellent. Urucú, a red or yellowish-red dye prepared from the pulp surrounding the seeds of this tree, is predominantly used as a body paint and the Yanomama believe that it possesses certain spiritual qualities and/or magical properties.

The use of rendered tapir (*Tapirus* spp.) fat was also observed in the Central Basin. Protection was probably due to the physical rather than chemical nature of the fat.

To obtain additional data on chemicals that could be used to protect against black fly attack, four experimental repellents: AI3–30180 (*N,N*-dimethyl-4-(1-methylethyl) benzamide), AI3–35765 (1-(3-cyclohexen-1-ylcarbonyl)piperidine), AI3–35766 (1-(3-cyclohexen-1-ylcarbonyl(hexahydro 1*H*-azepine and AI3–35770 (hexahydro-1-[(2-methylcyclohexyl)carbonyl]-1*H*-azepine and a deet standard were utilized in preliminary studies at Aripuanã, Mato Grosso, Brazil, and at Uruá, Pará, Brazil in the Amazon National Park, Tapajós. Moderate to high levels of biting were observed at both locations throughout most of the year (Lacey in press; Lacey and Charlwood 1980).

At Aripuanã, *Simulium simplicicolor* Lutz, a large orange species and a small black species, *S. sanguineum* s.l. (½ to ⅓ the size of *S. simplicicolor*) were the dominant black flies attracted to man. At Uruá, *S. sanguineum* s.l. and a large grey species, *S. guianense* were the anthropophilic species present.

Repellents were applied as 1-ml aliquots of a 25% ethanol solution and spread evenly over the forearm of a subject from wrist to elbow. The ethanol solution was formulated on a weight-volume basis, so 250 mg of repellent was applied in each test.

Treated arms were continuously exposed to natural populations of flies. Subjects intermittently moved about with arms raised or on hips, squatted or sat down for brief periods. These positions, coupled with slow walking and standing every few minutes, appeared to be attractive to black flies and were used as standard procedure in all tests.

At Aripuanã (January 15, 1979) due to inclemency, the tests were run for only 8 hr. Each of 4 test subjects received 1 ml of deet on one forearm and one of the 4 experimental compounds on the other. The procedure pre-

sented by Schreck et al. (1979) was utilized except that head nets and gloves were not worn. The test conducted at Uruá (March 22, 1979) was initiated at 0900 hr and terminated at dark (1830 hr).

Complete protection was provided by the experimental compounds during the Aripuanã test and only a few bites were received on the deet-treated arms toward the end of the 8-hr period. The results of the Uruá evaluation are presented in Table 1. A slight warming sensation was felt by the test subjects where compounds other than deet had been applied.

Table 1. Results of paired tests of topically applied repellents at Uruá, Pará, Brazil. One ml of 25% repellent by weight in ethanol solution was applied to each forearm.

Repellents used in tests paired with deet	Bites received and time (min.) from application to each bite					Total no. bites
	1st	2nd	3rd	4th	5th	
30180	320	528	537	547		4
Deet	320					1
35765	340	493*				2
Deet	280*	390*				2
35766	443					1
Deet	545					1
35770						0
Deet	430*	464	469	508	531	5

* *Simulium sanguineum* s.l. (biting rate on untreated control 60/hr) all others *Simulium guianense* (biting rate on untreated control 300/hr).

The biting rates for each of the test locations varied considerably depending on the time of day (Lacey and Charlwood 1980). *Simulium simplicicolor* and *S. guianense* displayed preference for biting in the early morning and late afternoon, especially at dusk. This provided the highest biting pressure when the test compounds were expected to be nearing the limits of the protection time.

Biting rates at Aripuanã averaged ca. 120/hr for *S. sanguineum* s.l. and ca. 60/hr for *S. simplicicolor*. At Uruá biting rates were ca. 60/hr for *S. sanguineum* s.l. and ca. 300/hr for *S. guianense*.

Temperature and humidity readings for the two areas during the studies were:

Uruá (March 20–31, 1979)
Temperature: Min. 24°C Max. 32°C
Humidity: 65% 90%
Aripuanã (January 8–15, 1979)
Temperature: Min. 22.5°C Max. 28.7°C
Humidity: 67% 96%

Candidate AI3–35770 received no bites from the species tested at both locations.

Against *S. sanguineum* s.l., deet was effective in 2 tests during the entire time allotted for testing and in 2 tests for 280 and 430 min to the 1st bite. Neither of these bites were confirmed by a 2nd bite within 30 min, however. Candidate AI3–30180 was effective for 528 min with a confirmed bite at 537 min.

Against *S. guianense* in 1 test, protection time for deet was 464 min, while unconfirmed bites occurred at 320 and 545 min in 2 other tests.

Although these tests were preliminary in nature and the number of biting flies was low compared to that which was observed in Maine (Schreck et al. 1979), the results obtained in this study indicate that compounds such as those tested at Uruá and Aripuanã will provide temporary protection against black flies and the diseases they carry in the Amazon Basin. Additional research into the efficacy of experimental compounds and on the efficacy and nature of native repellents such as Copaíba oil is warranted.

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ADDITIONAL RECORDS OF *SIMULIUM DEFOLIARTI* AND *PROSIMULIUM ONYCHODACTYLUM* FROM SOUTHERN CALIFORNIA

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On August 11, 1980, 34 larvae (3 second and third, 4 fourth and 27 fifth instars) and 18 pupae were collected from a small cool creek in the San Gorgonio Mountains, San Bernardino County, California. The majority of the larvae and pupae were aggregated on the rocky substrate of the bottom in the swiftest parts of the creek where water velocity was in the range of 70–150 cm/sec. Upon identification, the 3 second and third instar larvae were found to be *Simulium* (*Hearlea*) *canadense* Hearl; samples of the rest of the collection were sent to Dr. B. V. Peterson, Canada Department of Agriculture, Ottawa, Canada, for identification.

The larval and pupal materials were determined as follows: middle and 1 penultimate instar larvae and all pupae were *Simulium* (*Gnus*) *defoliarti* Stone and Peterson and the rest of the larvae (3 fourth instars and 26 fifth instars) were *Prosimulium* (*Heldon*) *onychodactylum* Dyar and Shannon. The material is deposited in the Insect Museum, Department of Entomology, University of California, Riverside, California.

S. defoliarti was 1st described by Stone and Peterson in 1958, having widespread distribution in many of the mountain creeks and streams of the western United States. In California, this species was collected from Alpine, Eldorado, Fresno, Inyo, Plumas, Sierra and Trinity Counties. Larvae and pupae of *S. defoliarti* were collected from rough, turbulent water with a current velocity of 100.6–167.6 cm/sec and as low as 25 cm/sec. Stone and Peterson (1958) found *S. defoliarti* to overwinter in the egg stage, larvae appear in late May or early June and adult emergence peak in mid-July. Recently, female adults of *S. defoliarti* were reported by Fredeen (1977) as an economic livestock pest which, together with *Simulium arcticum* Malloch, inflicts vicious and sometimes fatal massive attacks on animals in British Columbia, Canada.

P. onychodactylum was first collected and described by Dyar and Shannon in 1927 from Long's Peak, Colorado at an altitude of 3,353 m (11,000 ft). Wirth and Stone (1956) reported the occurrence of *P. onychodactylum* in California, however no detailed distribution was given. It is believed that this species has one generation per year in Utah (Peterson 1959) and overwinters in the egg stage in Alaska (Sommerman et al. 1955). In western Canada, larvae of *P. onychodactylum* are generally found from May until mid-July in streams with varying water velocities. The larvae and pupae attach to various aquatic vegetation, submerged sticks, branches and rocks (Peterson 1970). The cocoons of *P. onychodactylum* are often seen densely covered with small rock particles which makes it difficult to find the pupae (Peterson 1970). Two pupae with the same characteristics were collected from the Indian Creek, San Jacinto Mountains (altitude = 1646 m) in May, 1978, in a 2-year ecological study (Mohsen and Mulla, unpublished data) and were sent to B. V. Peterson for identification. Their identity, however, was not possible to confirm because they were early pupae (B. V. Peterson, personal communication). *P. onychodactylum* seems to prefer cool creeks, streams and rivers located at high altitudes (1646+ m) in the San Gorgonio and San Jacinto Mountains of southern California.