OPERATIONAL AND SCIENTIFIC NOTES

FIELD EVALUATION OF BLACKFLY CONTROL—AERIAL APPLICATIONS [1]

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To alleviate the irritation and annoyance caused by the blackflies at Camp Drum, New York, a preliminary study was initiated to determine whether relief from annoyance by blackflies could be obtained without using persistent insecticides. The objectives of this evaluation were to determine: (1) effectiveness of aerial dispersal of standard insecticides as adulticides; (2) re-entry time of blackflies after spraying and (3) whether or not aerial spraying could provide 48–72 hours of protection against blackflies.

MATERIALS AND METHODS. The study was conducted for 8 weeks during May and June at Camp Drum, which is a Class I installation of the First US Army; located nine miles east of Watertown, New York. In excess of 90,000 troops, principally from the 15 northeastern states receive their regular 2 weeks annual training here. This training site comprises a total of 107,000 acres and has a maximum elevation of approximately 800 feet. The prevailing winds were southwest to northeast and the mean temperature, relative humidity and windspeed during the evaluation were 61.5° F, 57% and 8.8 mph, respectively. Old New York State Route #26 was selected as the locale for the test site, and a total of 20 square miles was sprayed with different dosages, insecticides and flow rates.

To ascertain what effect aerial spraying of various non-persistent insecticides over 5-square-mile plots would have against blackflies, 4 spray missions were flown by the USAF Special Aerial Spray Flight Unit, Lockbourne AFB, Ohio. Four test plots, plus one control site, each 5-square-miles, were selected for this evaluation. The aircraft used to apply the insecticide solutions was a USAF UC-123K, equipped with a Fairchild Internal Pressure-Spray System (IPSS), with conventional booms and Teejet® flat-fan nozzles ranging from 8003 to 8006 that were set 45° down and into the wind. Line pressures ranged from 40 psi to 85 psi and flow rates were controlled by the size and number of nozzles used. The aircraft operated at a speed of 150 miles per hour, at an altitude of 150 feet for a 500 foot swath interval and at 200 feet for a swath interval of a 1000 feet. The spraying was done in the evenings, commencing about 2 hours before sunset.

The 95% malathion was dispersed through twelve 8003 Teejet nozzles with a boom pressure of 42 pounds psi. Two passes of this treatment were made to disperse a total dosage of 6 oz per acre. The Dibrom® was dispersed through eight 8003 nozzles with a boom pressure of 57 psi. The Dibrom plus Stabilene® combination was dispersed through twelve 8006 nozzles with a boom pressure of 85 psi. The 57% malathion was dispersed through forty-four 8006 nozzles with a boom pressure of 40 psi. The following theoretical dosages were applied on the target areas: 6 fluid ozs. per acre of 95% malathion; 1 fluid oz of Dibrom; 5 ozs. of Dibrom plus Stabilene [4] and 12 ozs. per acre of 57% malathion.

Sampling stations were established and counts of blackflies along with observations of behavior under various parameters of time, temperature, light and wind velocity were accomplished on a daily basis.

Weather conditions such as wind velocity, direction, speed and temperature existing at the training site were determined by the weather station at Camp Drum. In addition, local weather observations at the test sites were also made before, during and after each application.

The spray application was assessed by the exposure of captured flies held in nets (mesh size #30) and by taking in each plot pre- and post- blackfly counts of the natural adult population. To determine the effects of the aerosols on the natural population at least 2 hours prior to each application, the investigators swept three times above their heads with a standard handnet every 15 seconds and took the highest count at 15-minute intervals until the actual treatment occurred. After each sweep, flies were killed by crushing in the nets to prevent recapture. Immediately after the spray, re-entry time was noted by counting the number of minutes elapsing before the flies were seen to return to the investigator. After determining the re-entry time, the investigators then conducted fly counting in the manner described above at 15-minute intervals until dark. This procedure was designated as the "post-count." To determine the kill of trapped flies, adult blackflies were collected in

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[4] Butoxypolypropylene Glycol 100% (8.25 lbs/gal).

standard handsweep-nets and also in the passenger cab area of the investigators' trucks with an aspirator. They were then placed in clean nets and later located on the open road or in the bed of the investigators' trucks. In all tests the blackflies were exposed throughout the spray application.

At least a dozen oil-red dye cards were placed horizontally within each site on metal stands to determine droplet density. Teflon-coated microscope slides were also placed on existent wooden stakes to collect droplets dispersed from the aerial applications. Droplet sizes were computed using the technique described by Yeomans (1949). Sampling stations were spaced at 1 mile intervals along each test site.

RESULTS. Four aerial spray missions were flown during the period 24 May–14 June 1973. On one occasion three applications were applied at three different sites on the same day with the weather and biological parameters being equal.

The effect of aerial spraying as a control measure for adult blackflies was unsatisfactory. The kill of trapped blackflies for all treatments as well as the natural population is seen in Table 1. The data on kill of trapped blackflies along with the natural population at all test sites, as well as weather observations, definitely showed that this poor control was attributed to many variable factors other than re-entry and re-infiltration by blackflies.

At windspeeds above 7 mph it was apparent that the spray applications were not effective and this was directly correlated with reduced fly activity. Temperature was also a factor which significantly influenced blackfly activity as well as light intensity. This was clearly demonstrated by the high rate of kill for trapped flies with the malathion 95% treatment. The temperature at the time of application was 70° F and at the end of the application it was 69° F. All other applications had temperature changes anywhere from 5–13 degrees. It was noted that blackfly activity diminished rapidly with a decrease in light intensity as seen before sunrise and sunset. There was no evidence that humidity was a factor.

The droplet distribution on the dye cards was directly correlated to increased windspeeds during most of the spraying operations. This was evidenced by the fact that some dye cards had adequate coverage whereas others had scattered distribution. There was no difference in droplet distribution for those dye cards placed on the open road and/or under vegetative cover other than that due to increased windspeeds. The droplet sizes for each compound tested are seen in Table 2.

It can clearly be seen that aerial spraying was ineffective, but one must consider the variables associated with blackfly activity, as well as the inherent errors of ULV applications of a pesticide. Thompson (1973) reported that when an effective application rate is found, work should be extended to define that rate in terms of the amount of insecticide in a specific solvent, of droplet size and droplets per given unit area. Perhaps a more dilute solution of the insecticides used would have been more effective for blackfly control. Physical parameters such as temperature, humidity, light and windspeed are very critical to the blackfly and if adult control is to be achieved, the compounds must be applied whenever most of the flies are on the wing. The conditions under which the experiments were conducted were not that ideal.

The adverse weather conditions (wind and temperature) which prevailed at Camp Drum made it difficult, if not impossible, to select an ideal time to treat the sites with the compounds tested. The winds and temperatures at Camp Drum are analogous to the breezes and temperatures one finds at the beach. In the early morning, there is little wind; however, the tempera-

TABLE 1. Control of natural and trapped adult blackflies, *S. venustum* and *P. hirtipes* with ULV aerial sprays.

Insecticide	Site #	Avg temp	Avg windspeed (mph)	Dose rate (fl oz/acre)	[a] Pre-treatment count per man	[b] Post-treatment count per man	% kill of trapped flies
Malathion 95%	26–3	69° F	8	6	17	18	100
Malathion 57%	26–6	63° F	6	12	5	7	0
Dibrom 14	26–1	60° F	8	1	5	6	30
Dinbrom plus Stabilene	26–R	65° F	9	5	12	14	0
Untreated	26–C	68° F	8	0	16	16	0
Untreated	26–C	63° F	6	0	9	10	0
Untreated	26–C	60° F	8	0	8	8	0
Untreated	26–C	64° F	9	0	15	16	0

[a] Average count per man after taking counts at 15 minute intervals before actual treatment.
[b] Average count per man after taking counts at 15 minute intervals until dark.

TABLE 2. Size of droplets collected with aerial application of insecticides when applied with USAF UC-123K aircraft

Insecticide	Dose (lb per acre)	Volume (fl oz per acre)	Dispersal altitude (feet)	Teejet (no.)	Nozzle (size)	Line (PSI)	Micron diameter range	Average diameter (Micron)
Malathion 95%	0.45	6[1]	150	12	8003	42	5–110	33
Malathion 57%	0.54	12	200	44	8006	40	5–123	35
Dibrom—14	0.10	1	200	8	8003	57	19–114	45
Dibrom plus repellent [2]	0.10/0/25	5	150	12	8006	85	4–237	40

[1] 2 passes at 3 oz per acre.
[2] Stabilene (8.26 lbs/gal).

tures are too low for dispensing insecticides since most of the compounds start to crystallize at temperatures below 70° F. About 9 a.m. the wind picks up and stays rather active with gusts greater than 10 mph until sometime late in the afternoon depending upon whether its direction shifts to direct north or not. In the evening, prior to sunset, the wind dies down, but the temperature also drops making conditions for aerial spraying unsatisfactory. The investigators feel that typical weather conditions at Camp Drum are not ideal for aerial spraying and that new compounds, which are effective at lower temperatures, should be considered for future tests.

It appears that an area greater than 5 square miles is also required to prevent rapid re-entry and infiltration of the natural blackfly population outside of the perimeter not sprayed. Perhaps something like 50–60 square miles is needed to reduce blackfly populations for an area like Camp Drum. Consideration for such control measures may not be economically feasible when one determines the financial support needed.

All of the aforementioned variables concerning ULV dispersal and adult blackfly control need further evaluation. It would appear that observations over several seasons are required to evaluate such factors as windspeed, light intensity and temperature.

Satisfactory control was not achieved with 500 and 1000 foot swath intervals with the Air Force UC-123K aircraft, but additional research needs to be done to determine whether other compounds, with different formulations could be utilized for adult blackfly control programs.

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HOW MANY BLOOD MEALS DOES A MOSQUITO TAKE? [1]

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One of the most basic questions concerning the physiology of feeding in mosquitoes is: how many blood meals will a female take during her entire life span? As far as we are aware, no one has approached this problem in a highly critical way with any species of mosquito. Although Christophers (1960) stated that his strain of *Aedes aegypti* (L.) females took only 1 blood meal before developing each batch of eggs, some other workers have reported that their strains took more than 1 per gonotrophic cycle (Macfie, 1915; Howard, 1923). In searching the literature, we

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