# MEASURING STREAM DISCHARGE AND CALCULATING TREATMENT OF RATES OF *BACILLUS THURINGIENSIS* (H14) FOR BLACK FLY CONTROL[1]

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ABSTRACT. A modified float method for measuring stream discharge for black fly control is presented as well as a calculator program to assist in calculations and to provide a printed record. In addition, a calculator program is presented that provides a method for calculating rates of material [specifically *Bacillus thuringiensis* var. *israelensis (Bti)*] to be applied to streams for black fly control and cost for treatment.

A limitation to routine control of black flies is finding a simplified, yet accurate, method of determining stream discharge (flow rate) and subsequently determining how much material to apply for control. Most materials are applied to streams at parts per million rates (i.e. mg of control agent per liter of water). Hocking et al. (1949) gave instructions for estimating stream discharge for black fly control by measuring stream cross sectional area and then determining the maximum velocity (Vm) through this cross section by passing a float over a measured distance; they estimated mean velocity (Va) = ⅔ Vm. (Discharge = cross-sectional area × Va). The accuracy of the float method was determined to be within 5% of the more accurate Gurley current meter method (Hocking 1950). Wallace et al. (1973) calculated average water depth by taking a series of measurements at one meter intervals across the stream; an average stream width was determined from the average of three tape measurements (10 m apart); and an average water velocity was estimated with a Gurley current meter. Wallace et al. (1976) used a dye dilution method for calculating discharge. However, this method is inaccurate unless mixing of the dye is very thorough and uniform across the entire section of the stream (Bean 1971). Fredeen (1974, 1975) used discharge data supplied by gaging stations on the Saskatchewan River systems.

Stream discharge is most accurately measured by taking a series of closely spaced depth and velocity measurements using a calibrated current meter (Bean 1971, Buchanan and Somers 1969, Hammer and MacKichan 1981). However, current meters are expensive and considerable labor is required to achieve a high degree of accuracy. For the purpose of black fly control, the author believes that ± 10% error in calculations of discharge is acceptable. The method below is designed for use by control personnel using readily available materials and was developed following consultation with stream hydrologists (West Virginia Geological Survey). Individuals planning black fly control should first contact the State Geological Survey since many larger streams have automatic gaging stations and "instantaneous" discharge information can be easily obtained by phone, thus saving considerable labor.

MEASURING STREAM DISCHARGE. Select a straight reach of the stream with a narrow and uniform cross section (some irregular, or turbulent rocky streams may present considerable difficulty in finding a suitable point of measurement). "The ideal measuring section has a smooth bottom and fairly uniform depth, the velocity is well distributed across the stream, and the flow is perpendicular to the section" (Hammer and MacKichan 1981). Divide larger or complex streams into partial sections. Accurately measure the width and average of each partial section and calculate the partial area. Set up a measured distance for timed passage of a float over the center of each section (approximately 10 seconds duration gives accurate velocity measurements). Release a float a few meters upstream so that it passes over the center of the partial section. Be careful to insure a low float profile to reduce wind influence on velocity measurement (I found ping-pong balls painted bright orange and injected with 25 cc $H_2O$ to be very useful). Each calculated velocity is then reduced by 0.85 to compensate for bottom resistance (Buchanan and Somers 1969). The product of partial areas and respective velocities gives partial discharges which are summed to give the stream discharge. Careful measurements can give discharges with an error of ± 10%, which the author believes is adequate for black fly control work (Buchanan and Somers 1969, Bean 1971).

Considerable time can be saved by using a programmable, hand-held calculator in the field to make calculations. The author devel-

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[2] Mention of proprietary products does not represent endorsement of such products by West Virginia University or the state of West Virginia.

oped the following program for the Texas Instrument TI 59®[2] with print cradle. This instrument allows the operator to record programs on magnetic cards, for subsequent use. (Send blank magnetic cards to author for a copy).

*Program Procedure:*

1. Enter the 362 program steps listed in Fig. 1.
2. List the partial widths, depths, and velocities (in meters or meters/second) in tabular form.
3. Store partial widths (up to 10 measurements) by entering the first value and then depressing label A; entering the second value then depressing the key, R/S; the third value, R/S; etc.
4. Store average depths corresponding to partial widths by entering the first value then depressing label B; the second value, R/S, etc.
5. Store average velocities corresponding to partial sections by entering the first value, then depressing label C; second value, then R/S; etc.
6. Perform calculations by depressing label D. The cradle will print "Discharge = ," then print the value followed by "CM/S" (cubic meters per second). (To convert to 1/s, multiply by $10^3$; to convert to cubic feet/sec, multiply by 35.315).
7. If more than 10 partial widths are measured (e.g. when performing accurate stream gaging with a current meter and frequent measurements, (see Buchanan and Somers 1969) enter the values in sets of 10, as above. After each calculation press label A′ (to sum calculations) and then press label E (to clear memories without losing data). When all measurements have been calculated press label B′. The cradle will print "Total Discharge = ," then print the discharge followed by "CM/S." (This step requires that the calculator be attached to a print cradle).

CALCULATING RATES OF *B. thuringiensis* (H14). A person planning black fly control should apply the *B. thuringiensis* formulation to a stream as parts per millions (mg per liter) over a preestablished period of treatment (1, 15 or 30 min.) (Undeen and Lacey 1982). In a situation involving considerable mixing when the material is released (e.g. in a stilling basin below a dam), application of the material at one quick release (= 1 min.) is probably justified. In other situations, the application may have to be extended over several minutes to insure that a higher proportion of the black fly larvae will feed on the *B. thuringiensis* before it passes (approximately 15 or 30 min. release duration). In all cases, the mass of water containing *B. thuringiensis* tends to become lengthened during passage downstream, and the greater the ratio of impounded water to discharge, the greater the dilution effect or apparent lengthening of the "slug" as it passes downstream. The basic information required to estimate rate of *B. thuringiensis* application is stream discharge, duration of treatment in minutes, and parts per million applied. Parts per million varies according to the target species concerned: 0.5 and 1.0 ppm are most frequently found to be effective for black fly control (see recommendations of manufacturers[3]).

One factor to take into consideration is the ratio of discharge to volume of "impounded" waters, i.e., the volume of natural deep holes, small dams, reservoirs and the volume of slow-moving stretches along the waterway. Such impounded waters greatly dilute the rate applied to the discharge and also both lengthen and delay the passage of the slug. If a stream has many such impoundments, the rate should be increased accordingly.

The author's experience of using *B. thuringiensis* for mosquito control has indicated a possible susceptibility of the *B. thuringiensis* preparation to ultraviolet light (treated water samples collected and returned immediately to the lab remained active indoors for several days; treated water collected in the field after 24 hr had no activity). For this reason, it may be wise to delay application until late afternoon to prevent the possibility of impaired activity. Many other parameters should be considered carefully before control is initiated (Undeen and Lacey 1982).

When discharge is given in liter/second, the rate is determined by the formula: discharge ($\ell$/sec) X 60 (sec/min) X (no. minutes) X ppm ($10^{-6}$) = kg *B. thuringiensis*. A program was developed for the TI 59 and print cradle for producing labeled calculations of rates of *B. thuringiensis* to be applied (kg) and cost per treatment.

*Program Procedure For Calculating* B. thuringiensis *(H14) Rates and Cost:*

1. Enter the 185 program steps listed in Fig. 2; store the following values in the registers indicated. $10^6$, R-00; 60, R-04.
2. Enter liters per second, depress label A; enter minutes duration, depress label B; enter parts per million (the integer less the

[3] Biochem Products, P.O. Box 264, Montchanin, DE 19710; Sandoz Inc., 480 Camino Del Rio So., San Diego, CA 92108; Abbott Laboratories, North Chicago, IL 60064.

| a | b | c | a | b | c | a | b | c | a | b | c | a | b | c | a | b | c | a | b | c | a | b | c |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 000 | 76 | LBL | 048 | 91 | R/S | 096 | 76 | LBL | 144 | 31 | 31 | 192 | 43 | RCL | 240 | 04 | 4 | 288 | 69 | OP | 336 | 03 | 3 |
| 001 | 11 | A | 049 | 42 | STO | 097 | 14 | D | 145 | 43 | RCL | 193 | 19 | 19 | 241 | 00 | 0 | 289 | 01 | 01 | 337 | 03 | 3 |
| 002 | 42 | STO | 050 | 16 | 16 | 098 | 00 | 0 | 146 | 05 | 05 | 194 | 65 | × | 242 | 00 | 0 | 290 | 02 | 2 | 338 | 06 | 6 |
| 003 | 01 | 01 | 051 | 91 | R/S | 099 | 42 | STO | 147 | 65 | × | 195 | 43 | RCL | 243 | 00 | 0 | 291 | 07 | 7 | 339 | 69 | OP |
| 004 | 91 | R/S | 052 | 42 | STO | 100 | 31 | 31 | 148 | 43 | RCL | 196 | 29 | 29 | 244 | 00 | 0 | 292 | 00 | 0 | 340 | 04 | 04 |
| 005 | 42 | STO | 053 | 17 | 17 | 101 | 43 | RCL | 149 | 15 | 15 | 197 | 95 | = | 245 | 69 | OP | 293 | 00 | 0 | 341 | 43 | RCL |
| 006 | 02 | 02 | 054 | 91 | R/S | 102 | 01 | 01 | 150 | 65 | × | 198 | 44 | SUM | 246 | 04 | 04 | 294 | 01 | 1 | 342 | 40 | 40 |
| 007 | 91 | R/S | 055 | 42 | STO | 103 | 65 | × | 151 | 43 | RCL | 199 | 31 | 31 | 247 | 98 | ADV | 295 | 06 | 6 | 343 | 69 | OP |
| 008 | 42 | STO | 056 | 18 | 18 | 104 | 43 | RCL | 152 | 25 | 25 | 200 | 43 | RCL | 248 | 69 | OP | 296 | 02 | 2 | 344 | 06 | 06 |
| 009 | 03 | 03 | 057 | 91 | R/S | 105 | 11 | 11 | 153 | 95 | = | 201 | 10 | 10 | 249 | 05 | 05 | 297 | 04 | 4 | 345 | 98 | ADV |
| 010 | 91 | R/S | 058 | 42 | STO | 106 | 65 | × | 154 | 44 | SUM | 202 | 65 | × | 250 | 69 | OP | 298 | 03 | 3 | 346 | 98 | ADV |
| 011 | 42 | STO | 059 | 19 | 19 | 107 | 43 | RCL | 155 | 31 | 31 | 203 | 43 | RCL | 251 | 00 | 00 | 299 | 06 | 6 | 347 | 98 | ADV |
| 012 | 04 | 04 | 060 | 91 | R/S | 108 | 21 | 21 | 156 | 43 | RCL | 204 | 20 | 20 | 252 | 01 | 1 | 300 | 69 | OP | 348 | 98 | ADV |
| 013 | 91 | R/S | 061 | 42 | STO | 109 | 95 | = | 157 | 06 | 06 | 205 | 65 | × | 253 | 05 | 5 | 301 | 02 | 02 | 349 | 00 | 0 |
| 014 | 42 | STO | 062 | 20 | 20 | 110 | 44 | SUM | 158 | 65 | × | 206 | 43 | RCL | 254 | 03 | 3 | 302 | 01 | 1 | 350 | 42 | STO |
| 015 | 05 | 05 | 063 | 91 | R/S | 111 | 31 | 31 | 159 | 43 | RCL | 207 | 30 | 30 | 255 | 00 | 0 | 303 | 05 | 5 | 351 | 40 | 40 |
| 016 | 91 | R/S | 064 | 76 | LBL | 112 | 43 | RCL | 160 | 16 | 16 | 208 | 95 | = | 256 | 06 | 6 | 304 | 02 | 2 | 352 | 91 | R/S |
| 017 | 42 | STO | 065 | 13 | C | 113 | 02 | 02 | 161 | 65 | × | 209 | 44 | SUM | 257 | 03 | 3 | 305 | 03 | 3 | 353 | 76 | LBL |
| 018 | 06 | 06 | 066 | 42 | STO | 114 | 65 | × | 162 | 43 | RCL | 210 | 31 | 31 | 258 | 03 | 3 | 306 | 01 | 1 | 354 | 15 | E |
| 019 | 91 | R/S | 067 | 21 | 21 | 115 | 43 | RCL | 163 | 26 | 26 | 211 | 00 | 0 | 259 | 06 | 6 | 307 | 03 | 3 | 355 | 43 | RCL |
| 020 | 42 | STO | 068 | 91 | R/S | 116 | 12 | 12 | 164 | 95 | = | 212 | 00 | 0 | 260 | 69 | OP | 308 | 03 | 3 | 356 | 40 | 40 |
| 021 | 07 | 07 | 069 | 42 | STO | 117 | 65 | × | 165 | 44 | SUM | 213 | 01 | 1 | 261 | 04 | 04 | 309 | 05 | 5 | 357 | 32 | X:T |
| 022 | 91 | R/S | 070 | 22 | 22 | 118 | 43 | RCL | 166 | 31 | 31 | 214 | 06 | 6 | 262 | 43 | RCL | 310 | 02 | 2 | 358 | 47 | CMS |
| 023 | 42 | STO | 071 | 91 | R/S | 119 | 22 | 22 | 167 | 43 | RCL | 215 | 02 | 2 | 263 | 31 | 31 | 311 | 02 | 2 | 359 | 32 | X:T |
| 024 | 08 | 08 | 072 | 42 | STO | 120 | 95 | = | 168 | 07 | 07 | 216 | 04 | 4 | 264 | 69 | OP | 312 | 69 | OP | 360 | 44 | SUM |
| 025 | 91 | R/S | 073 | 23 | 23 | 121 | 44 | SUM | 169 | 65 | × | 217 | 03 | 3 | 265 | 06 | 06 | 313 | 03 | 03 | 361 | 40 | 40 |
| 026 | 42 | STO | 074 | 91 | R/S | 122 | 31 | 31 | 170 | 43 | RCL | 218 | 06 | 6 | 266 | 98 | ADV | 314 | 01 | 1 | 362 | 91 | R/S |
| 027 | 09 | 09 | 075 | 42 | STO | 123 | 43 | RCL | 171 | 17 | 17 | 219 | 01 | 1 | 267 | 98 | ADV | 315 | 07 | 7 | | | |
| 028 | 91 | R/S | 076 | 24 | 24 | 124 | 03 | 03 | 172 | 65 | × | 220 | 05 | 5 | 268 | 98 | ADV | 316 | 00 | 0 | | | |
| 029 | 42 | STO | 077 | 91 | R/S | 125 | 65 | × | 173 | 43 | RCL | 221 | 69 | OP | 269 | 98 | ADV | 317 | 00 | 0 | | | |
| 030 | 10 | 10 | 078 | 42 | STO | 126 | 43 | RCL | 174 | 27 | 27 | 222 | 02 | 02 | 270 | 91 | R/S | 318 | 06 | 6 | | | |
| 031 | 91 | R/S | 079 | 25 | 25 | 127 | 13 | 13 | 175 | 95 | = | 223 | 02 | 2 | 271 | 76 | LBL | 319 | 04 | 4 | | | |
| 032 | 76 | LBL | 080 | 91 | R/S | 128 | 65 | × | 176 | 44 | SUM | 224 | 03 | 3 | 272 | 16 | A' | 320 | 00 | 0 | | | |
| 033 | 12 | B | 081 | 42 | STO | 129 | 43 | RCL | 177 | 31 | 31 | 225 | 01 | 1 | 273 | 43 | RCL | 321 | 00 | 0 | | | |
| 034 | 42 | STO | 082 | 26 | 26 | 130 | 23 | 23 | 178 | 43 | RCL | 226 | 03 | 3 | 274 | 31 | 31 | 322 | 00 | 0 | | | |
| 035 | 11 | 11 | 083 | 91 | R/S | 131 | 95 | = | 179 | 08 | 08 | 227 | 03 | 3 | 275 | 44 | SUM | 323 | 00 | 0 | | | |
| 036 | 91 | R/S | 084 | 42 | STO | 132 | 44 | SUM | 180 | 65 | × | 228 | 05 | 5 | 276 | 40 | 40 | 324 | 69 | OP | | | |
| 037 | 42 | STO | 085 | 27 | 27 | 133 | 31 | 31 | 181 | 43 | RCL | 229 | 02 | 2 | 277 | 91 | R/S | 325 | 04 | 04 | | | |
| 038 | 12 | 12 | 086 | 91 | R/S | 134 | 43 | RCL | 182 | 18 | 18 | 230 | 02 | 2 | 278 | 76 | LBL | 326 | 98 | ADV | | | |
| 039 | 91 | R/S | 087 | 42 | STO | 135 | 04 | 04 | 183 | 65 | × | 231 | 01 | 1 | 279 | 17 | B' | 327 | 69 | OP | | | |
| 040 | 42 | STO | 088 | 28 | 28 | 136 | 65 | × | 184 | 43 | RCL | 232 | 07 | 7 | 280 | 03 | 3 | 328 | 05 | 05 | | | |
| 041 | 13 | 13 | 089 | 91 | R/S | 137 | 43 | RCL | 185 | 28 | 28 | 233 | 69 | OP | 281 | 07 | 7 | 329 | 69 | OP | | | |
| 042 | 91 | R/S | 090 | 42 | STO | 138 | 14 | 14 | 186 | 95 | = | 234 | 03 | 03 | 282 | 03 | 3 | 330 | 00 | 00 | | | |
| 043 | 42 | STO | 091 | 29 | 29 | 139 | 65 | × | 187 | 44 | SUM | 235 | 00 | 0 | 283 | 02 | 2 | 331 | 01 | 1 | | | |
| 044 | 14 | 14 | 092 | 91 | R/S | 140 | 43 | RCL | 188 | 31 | 31 | 236 | 00 | 0 | 284 | 03 | 3 | 332 | 05 | 5 | | | |
| 045 | 91 | R/S | 093 | 42 | STO | 141 | 24 | 24 | 189 | 43 | RCL | 237 | 00 | 0 | 285 | 07 | 7 | 333 | 03 | 3 | | | |
| 046 | 42 | STO | 094 | 30 | 30 | 142 | 95 | = | 190 | 09 | 09 | 238 | 00 | 0 | 286 | 01 | 1 | 334 | 00 | 0 | | | |
| 047 | 15 | 15 | 095 | 91 | R/S | 143 | 44 | SUM | 191 | 65 | × | 239 | 06 | 6 | 287 | 03 | 3 | 335 | 06 | 6 | | | |

Fig. 1. Program for discharge calculations, for TI 59 Programmable Calculator. Column a is program step number, column b is calculator key position, column c is key label.

| a | b | c | a | b | c | a | b | c | a | b | c | a | b | c |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 000 | 76 | LBL | 040 | 03 | 3 | 080 | 06 | 06 | 120 | 07 | 7 | 160 | 01 | 1 |
| 001 | 11 | A | 041 | 06 | 6 | 081 | 69 | OP | 121 | 02 | 2 | 161 | 05 | 5 |
| 002 | 42 | STO | 042 | 69 | OP | 082 | 00 | 00 | 122 | 04 | 4 | 162 | 03 | 3 |
| 003 | 01 | 01 | 043 | 04 | 04 | 083 | 02 | 2 | 123 | 00 | 0 | 163 | 02 | 2 |
| 004 | 91 | R/S | 044 | 43 | RCL | 084 | 06 | 6 | 124 | 00 | 0 | 164 | 03 | 3 |
| 005 | 76 | LBL | 045 | 01 | 01 | 085 | 02 | 2 | 125 | 06 | 6 | 165 | 06 | 6 |
| 006 | 12 | B | 046 | 98 | ADV | 086 | 04 | 4 | 126 | 04 | 4 | 166 | 03 | 3 |
| 007 | 42 | STO | 047 | 69 | OP | 087 | 02 | 2 | 127 | 00 | 0 | 167 | 07 | 7 |
| 008 | 02 | 02 | 048 | 06 | 06 | 088 | 07 | 7 | 128 | 00 | 0 | 168 | 69 | OP |
| 009 | 91 | R/S | 049 | 69 | OP | 089 | 02 | 2 | 129 | 69 | OP | 169 | 04 | 04 |
| 010 | 76 | LBL | 050 | 00 | 00 | 090 | 07 | 7 | 130 | 04 | 04 | 170 | 43 | RCL |
| 011 | 13 | C | 051 | 03 | 3 | 091 | 03 | 3 | 131 | 69 | OP | 171 | 21 | 21 |
| 012 | 65 | × | 052 | 00 | 0 | 092 | 02 | 2 | 132 | 05 | 05 | 172 | 69 | OP |
| 013 | 43 | RCL | 053 | 02 | 2 | 093 | 69 | OP | 133 | 69 | OP | 173 | 06 | 06 |
| 014 | 00 | 00 | 054 | 04 | 4 | 094 | 01 | 01 | 134 | 00 | 00 | 174 | 69 | OP |
| 015 | 35 | 1/X | 055 | 03 | 3 | 095 | 02 | 2 | 135 | 43 | RCL | 175 | 00 | 00 |
| 016 | 95 | = | 056 | 01 | 1 | 096 | 02 | 2 | 136 | 09 | 09 | 176 | 98 | ADV |
| 017 | 42 | STO | 057 | 69 | OP | 097 | 03 | 3 | 137 | 99 | PRT | 177 | 98 | ADV |
| 018 | 03 | 03 | 058 | 04 | 04 | 098 | 05 | 5 | 138 | 43 | RCL | 178 | 98 | ADV |
| 019 | 91 | R/S | 059 | 43 | RCL | 099 | 01 | 1 | 139 | 09 | 09 | 179 | 98 | ADV |
| 020 | 76 | LBL | 060 | 02 | 02 | 100 | 03 | 3 | 140 | 65 | × | 180 | 91 | R/S |
| 021 | 14 | D | 061 | 69 | OP | 101 | 03 | 3 | 141 | 43 | RCL | 181 | 76 | LBL |
| 022 | 43 | RCL | 062 | 06 | 06 | 102 | 00 | 0 | 142 | 10 | 10 | 182 | 15 | E |
| 023 | 01 | 01 | 063 | 69 | OP | 103 | 03 | 3 | 143 | 95 | = | 183 | 42 | STO |
| 024 | 65 | × | 064 | 00 | 00 | 104 | 06 | 6 | 144 | 42 | STO | 184 | 10 | 10 |
| 025 | 43 | RCL | 065 | 03 | 3 | 105 | 69 | OP | 145 | 21 | 21 | 185 | 91 | R/S |
| 026 | 04 | 04 | 066 | 03 | 3 | 106 | 02 | 02 | 146 | 03 | 3 | | | |
| 027 | 65 | × | 067 | 03 | 3 | 107 | 00 | 0 | 147 | 03 | 3 | | | |
| 028 | 43 | RCL | 068 | 03 | 3 | 108 | 00 | 0 | 148 | 03 | 3 | | | |
| 029 | 02 | 02 | 069 | 03 | 3 | 109 | 03 | 3 | 149 | 05 | 5 | | | |
| 030 | 65 | × | 070 | 00 | 0 | 110 | 02 | 2 | 150 | 04 | 4 | | | |
| 031 | 43 | RCL | 071 | 69 | OP | 111 | 02 | 2 | 151 | 00 | 0 | | | |
| 032 | 03 | 03 | 072 | 04 | 04 | 112 | 01 | 1 | 152 | 69 | OP | | | |
| 033 | 95 | = | 073 | 43 | RCL | 113 | 00 | 0 | 153 | 04 | 04 | | | |
| 034 | 42 | STO | 074 | 03 | 03 | 114 | 00 | 0 | 154 | 43 | RCL | | | |
| 035 | 09 | 09 | 075 | 65 | × | 115 | 01 | 1 | 155 | 10 | 10 | | | |
| 036 | 02 | 2 | 076 | 43 | RCL | 116 | 04 | 4 | 156 | 69 | OP | | | |
| 037 | 07 | 7 | 077 | 00 | 00 | 117 | 69 | OP | 157 | 06 | 06 | | | |
| 038 | 06 | 6 | 078 | 95 | = | 118 | 03 | 03 | 158 | 69 | OP | | | |
| 039 | 03 | 3 | 079 | 69 | OP | 119 | 03 | 3 | 159 | 00 | 00 | | | |

Fig. 2. Program for dosage calculations for TI 59 Programmable Calculator. Columns are same as Fig. 1.

exponent), depress label C; enter price per kilogram, depress label E; and perform calculations by depressing label D. The cradle will print each value entered with notation at right margin (L/S, MIN, PPM, Pr., Cost) and then print "Kilograms BTI =" followed by the number of kg required for treatment, price and cost of the treatment.

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# ARTHROPODS COLLECTED FROM AIRCRAFT AT PIARCO INTERNATIONAL AIRPORT, TRINIDAD, WEST INDIES.[1]


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ABSTRACT. Insects were collected and identified from local and foreign aircraft entering Piarco International Airport, Trinidad, West Indies. Nine hundred and sixty-seven specimens were collected from 592 aircraft. The specimens collected represented eight taxonomic orders and 25 families. *Aedes aegypti*, an important vector of dengue and urban yellow fever, and *Anopheles albimanus*, a non-indigenous malaria vector were among those collected. *Musca domestica*, the house fly, was by far the most abundant insect in the collection, accounting for over 83% of the total catch. The need to maintain entomological surveillance at airports and seaports was encouraged.


## INTRODUCTION

The Insect Vector Control Division of the Ministry of Health and Environment, Trinidad and Tobago, West Indies, has maintained entomological surveillance at Piarco International Airport since 1939. Mosquitoes and other arthropods have been collected from aircraft and ships at international airports and seaports in many parts of the world (Soper and Wilson 1943, Pippin et al. 1968, Evans et al. 1963, Fox et al. 1961, Eads et al. 1965, Hughes 1961, Campos et al. 1961).

It has been shown that airport and seaport surveillance is an important feature of vector control, since in many tropical countries the vectors of a number of diseases occur in airport environments. Because of this fact, and due to increases in air travel, the chance of introduction of disease and associated vectors from one country to another has been increasing (Laird 1951, Highton and Van Someren 1970).

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