raising the temperature of the water to 50°C for 10 min, (2) filtration of the water, or (3) by the use of commercially bottled drinking water. Discontinuing the use of plant infusions would eliminate a source of contamination or, if used, such infusions should be prepared from field-sheared, aerial portions of plants or from plant parts that are free of any soil. The exclusion of all field collected larvae from healthy colonies, immediate disposal of cultures containing infected individuals, and subsequent sterilization of the containers and any contaminated instruments will also reduce or prevent the appearance of *Aphanomyces* and other zoosporic fungal infections in insectary populations of larval mosquitoes.

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References Cited

Scott, W. W. 1961. A monograph of the genus *Aphanomyces*. Va. Agric. Exp. Stn. Tech. Bull. 151:1–95.

Seymour, R. L. 1970. The genus *Saprolegnia*. Nova Hedwigia [Beiheft] 19:1–124.

Seymour, R., U. M. Cowgill, G. M. Klecka, F. M. Gersich and M. A. Mayes. 1984. Occurrence of *Aphanomyces daphniae* infection in laboratory cultures of *Daphnia magna*. J. Invertebr. Pathol. 43:109–113.

PORTABLE, BATTERY-POWERED ASPIRATORS FOR COLLECTING ADULT MOSQUITOES[1]

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Several types of aspirating devices have been described for collecting feeding and resting adult mosquitoes (Dowell 1965, Bailey 1966, Carver 1967, Hayes et al. 1967, Jackson and Grothaus 1971, Davis and Gould 1973, Sheldahl 1974, Meyer et al. 1983, McCreadie et al. 1984). Some of these devices are cumbersome and lack portability because of the limitations imposed by large electrical power sources, restrictive extension cords, vacuum hoses, etc. Fully portable models suitable for use in remote areas lack sufficient air flow for extended periods. Most designs do not permit easy and quick interchange of sample containers or bags which tends to impede the sampling process.

The first of two aspirators described herein is modified from a lightweight (0.77 kg), battery-powered, hand-held vacuum cleaner[4, 5]. The rechargeable cadmium batteries are located inside an impact-resistant, plastic handle (Fig. 1A). The manufacturer claims that batteries will remain functional for 5 years if stored at or about 10°C. The 0.31 kg handle is removable and easily replaced with another containing fully charged batteries[6]. When fully charged, sufficient power is available for approximately 15 min of continuous normal operation. The

[1] This equipment was developed during cooperative research among the State Agricultural Experiment Stations of Arkansas, California, Louisiana, Mississippi and Texas and the Agricultural Research Service, USDA, as part of the USDA/CRS Southern Regional Project S–122 on the Biology, Ecology and Management of Riceland Mosquitoes in the Southern Region.

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[4] Mention of a commercial product does not constitute a recommendation for use or endorsement for sale by Louisiana State University or the University of Arkansas.

[5] Black and Decker Model 9320 Spot Vac Head for the Mod 4® Cordless System of power tools. The Black and Decker Mfg. Co., Towson, MD 21204.

[6] Black and Decker Standard Cordless Energy Pak® #86–079 for use with Black and Decker Recharger #86–001.

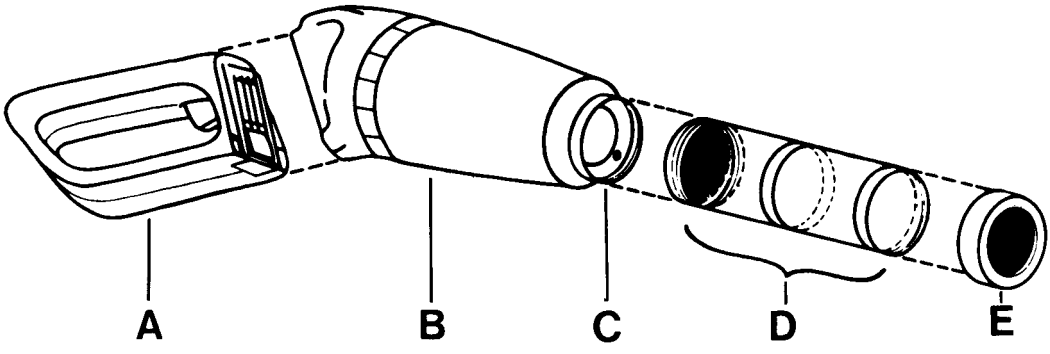

Fig. 1. Black and Decker Mod 4® cordless vacuum modified for aspirating small flying insects: (A) handle, (B) main body, (C) screw cap, (D) transparent plastic prescription vials, and (E) screened screw cap.

aspirator will operate at reduced speed for another 5 to 7 min on a depleted power supply. The aspirator is activated by depressing a trigger located comfortably under the handle grip. There is also a push button, locking switch on top of the main aspirator body (Fig. 1B) that permits continuous operation without constantly gripping the trigger.

The main body which is made of impact-resistant plastic, houses the motor and fan. The motor is covered with a protective cloth bag that prevents debris from inhibiting operation. Only one modification of the unit itself is required to adapt it for aspirating insects. The 2.54 cm tubular extension designed to hold vacuum cleaner attachments must be removed. It is important to remove as much of the extension tube as possible so that the cap (described below) will fit flush with the main body housing.

A plastic screw cap from a 20-dram transparent plastic prescription vial[7] is drilled (3.18 cm circular hole, centered) and then attached to the end of the main body housing (Fig. 1C). The cap should be attached so that its threaded inner rim faces outward to accept the threaded rim of a prescription vial. The cap must be positioned so that its opening is aligned with that on the main body housing that remains after removal of the extension tube. The cap is secured in place with three 1.9 cm machine screws (#4/40, countersunk head with hexnut) or 3 aluminum pop rivets placed equidistant around the perimeter of the cap hole. Caulking may be added to the space formed by the cap rim and the end surface of the main body. This will provide additional bonding and prevent air leaks.

Transparent plastic prescription vials are used as collection tubes for adult mosquitoes (Fig. 1D). Two vials are joined together to form a single collection tube approximately 12.07 cm long. Prior to bonding, the bottoms of the two vials should be removed. These nonthreaded ends of the vials are then placed together and bonded with epoxy cement. A 4.45 cm circular patch of plastic screen is placed over one threaded end of the collection tube and glued. Any excess screen is trimmed away. The mesh size of the screen is optional; however, a 50-mesh plastic screen is sufficient for general collecting. The screened end of the collection tube can now be screwed into the cap that is attached to the main body of the vacuum. When a sufficient number of mosquitoes are captured, a screened cap (Fig. 1E) is placed over the unscreened end of the collection tube to prevent escape.

The interchangeable collection tube offers considerable versatility in the mosquito sampling process. The large-mouth end of the collection tube, coupled with the powerful electrical motor, provides optimal air flow to capture numerous adult mosquitoes with minimal effort. The tubes can be removed and replaced in seconds which facilitates the collection of adult mosquitoes while taking landing rate counts in the field. The tubes containing specimens are easily transported to the laboratory for species identification.

Collection tubes can be constructed or modified using a variety of materials. For example, in an effort to maintain a standardization for sampling, transparent plastic cylindrical tubes and caps available in World Health Organization kits for testing insecticide resistance in adult mosquitoes (Brown and Pal 1971) can be used in place of the previously described prescription vials.

There are several additional attachments available that are designed by the manufacturer

[7] Stock # PR–320, available through Owens-Illinois, Production Products, Toledo, OH 43666.

to fit the handle: grass shear (#8986), shrub trimmer (#38983), 0.64 cm drill (#9000), and a sealed beam lantern (#9480). The lantern attachment has been used extensively by the authors and functions very well under field conditions.

Although the main body of the Spot Vac Head for the Mod 4 Cordless System® vacuum model has been discontinued and is no longer stocked in retail stores, a supply of reconditioned vacuums is available from the manufacturer. Newer models in the Dustbuster® series of hand-held vacuums are presently being marketed by the same manufacturer and can be easily modified to collect small flying insects, as noted by McCreadie et al. (1984) and as described herein (Fig. 2).

The Dustbuster Plus® cordless vacuum is also constructed of impact-resistant plastic and is powered by rechargeable batteries. It weighs approximately 0.77 kg and has a larger capacity motor (6.0 volts) that provides a greater air flow than the regular model Dustbuster (3.6 volts) as described by McCreadie et al. (1984). The vacuum is supplied with a charger base, equipped with a 120-volt electrical charger, and several attachments including a crevice tool (Fig. 2B). By modifying the crevice tool, the previously described collection tube can be attached. The modification involves cutting apart the crevice tool approximately 8.9 cm from the flanged end and attaching two pieces of 0.32 cm triangular-shaped Plexiglas® with hot glue to either side of the crevice tool as shown in Figure 2C. Each triangular piece measures approximately 2.79 cm at the base and 3.81 cm in height. A screw cap from a prescription vial, as previously described, is attached to the modified end of the crevice tool (Fig. 2D). Rather than making a circular hole in the cap, a 1.91 × 2.54 cm rectangular opening is made that permits a more suitable fit with the end of the crevice tool. Hot glue is then applied to secure the cap to the crevice tool. By making these modifications the collection tube (Fig. 2E–G), described previously, can be attached for use

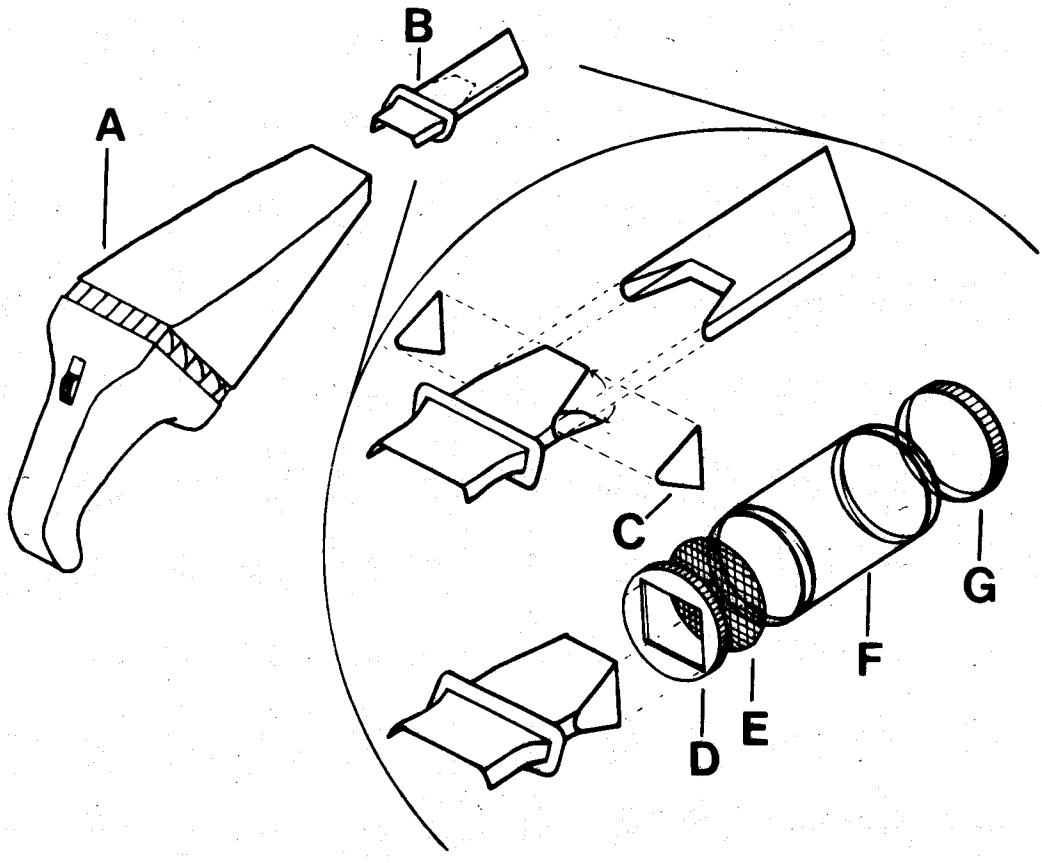

Fig. 2. Black and Decker Dustbuster Plus® cordless vacuum modified for aspirating small flying insects: (A) vacuum, (B) crevice tool, (C) triangular Plexiglas®, (D), screw cap, (E) 50-mesh plastic screen, (F) transparent plastic prescription vials, and (G) screened screw cap.

with the Dustbuster Plus cordless vacuum. Since all of the modifications involve only the crevice tool, the vacuum can still be used in the laboratory for general cleanup as originally designed.

The cost per aspirator, regardless of model type discussed, is approximately $35.00. This cost includes the total unit with the appropriate charger base, batteries, accessory attachments, etc.

In summary, we believe that the units described, and the detailed instructions for converting them into aspirators for small flying insects, offer several distinct advantages to ones previously described in the literature. Besides being portable, lightweight, battery-powered and durable, the most important advantage for field operations is the quick and easy disconnection and reattachment of sample containers (i.e., less "down time").

References Cited

Bailey, S. F. 1966. A suction-type collecting apparatus for mosquitoes. Mosq. News 26:585.

Brown, A. W. A. and R. Pal. 1971. Insecticide Resistance in Arthropods. World Health Organization Monograph No. 38, Geneva, Switzerland, pp. 53–56.

Carver, H. D. 1967. A portable aspirator for collecting mosquitoes. Mosq. News 27:428–429.

Davis, E. W. and D. J. Gould. 1973. A portable suction apparatus for collecting mosquitoes. Mosq. News 33:246–247.

Dowell, F. H. 1965. A heavy-duty power aspirator for collecting large numbers of adult mosquitoes. Mosq. News 25:325–327.

Hayes, R. O., G. E. Kitaguchi and R. M. Mann. 1967. The "CDC sweeper," a six volt mechanical aspirator for collecting adult mosquitoes. Mosq. News 27:359–363.

Jackson, S. C. and R. H. Grothaus. 1971. A combination aspirator and killing tube for collecting mosquitoes and other insects. Mosq. News 31:112–113.

McCreadie, J. W., M. H. Colbo and G. F. Bennett. 1984. A trap design for the collection of haematophagous Diptera from cattle. Mosq. News 44:212–216.

Meyer, R. P., W. K. Reisen, B. R. Hill and V. M. Martinez, 1983. The "AFS sweeper," a battery-powered backpack mechanical aspirator for collecting adult mosquitoes. Mosq. News 43:346–350.

Sheldahl, J. A. 1974. A simple conversion of a back pack mist-blower into an efficient power aspirator. Mosq. News 34:166–169.

ISOLATION OF AN ORGANOPHOSPHATE SUSCEPTIBLE STRAIN OF *CULEX QUINQUEFASCIATUS* FROM A RESISTANT FIELD POPULATION BY DISCRIMINATION AGAINST ESTERASE-2 PHENOTYPES[1]

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Investigations of insect resistance to insecticides are often hindered by the absence of genetically related susceptible strains to which tolerances can be compared. These strains are also essential in the elucidation of the biochemical and genetic characteristics of resistance.

The southern house mosquito, *Culex quinquefasciatus* Say, is a common pest problem in California, with multi-resistance often hindering effective control (Womeldorf et al. 1968, Apperson and Georghiou 1974, Al-Khatib 1983[2]). Many authors have found this species a convenient tool for studies of the evolution of resistance and in biochemical or genetic research (Georghiou et al. 1975, Ranasinghe 1976[3], Lagunes 1980[4], Ferrari and Georghiou 1981, Pasteur et al. 1981, Vazquez-Garcia 1983[5], Al-Khatib 1983[2], Hemingway and Georghiou 1984).

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[2] Al-Khatib, Z. I. 1983. Compatibility and biotic potential of different genotypes of OP-resistant *Culex quinquefasciatus* Say (Diptera: Culcidae) with reference to strategies for disrupting the development of resistance. Ph.D. dissertation, University of California, Riverside. 242 pp.

[3] Ranasinghe, L. B. E. 1976. Role of synergists in the selection of specific organophosphorus resistance mechanisms in *Culex quinquefasciatus* Say (Diptera: Culicidae). Ph.D. dissertation, University of California, Riverside. 122 pp.

[4] Lagunes, A. L. 1980. Impact of the use of mixtures and sequences of insecticides in the evolution of resistance in *Culex quinquefasciatus* Say (Diptera: Culicidae). Ph.D. dissertation, University of California, Riverside. 209 pp.

[5] Vasquez-Garcia, M. 1983. Investigations of the potentiality of resistance to *Bacillus thuringiensis* ser. H-14 in *Culex quinquefasciatus* through accelerated selection pressure in the laboratory. Ph.D. dissertation, University of California, Riverside. 201 pp.