# A Droplet Collection Device and Support System for Ultra-Low-Volume Adulticide Trials

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Source: Journal of the American Mosquito Control Association, 26(2):229-232. 2010.
Published By: The American Mosquito Control Association
DOI: 10.2987/10-5999.1
URL: http://www.bioone.org/doi/full/10.2987/10-5999.1

*Journal of the American Mosquito Control Association*, 26(2):229–232, 2010


# OPERATIONAL NOTE

## A DROPLET COLLECTION DEVICE AND SUPPORT SYSTEM FOR ULTRA-LOW-VOLUME ADULTICIDE TRIALS

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ABSTRACT. A supporting stand to suspend rotating impactors and mosquito cages is a requirement for field tests during pesticide efficacy trials. We present schematics for a collection device and associated support system for sampling droplets of ultra-low-volume (ULV) sprays during mosquito adulticide applications. This system offers the advantages of cost efficiency, increased ease of deployment, off-season storage, visibility, stability, and ULV collection efficacy. Use of this system ensures that droplet collection and meteorological equipment is at appropriate and consistent heights between trials. The 2 arms of the support allow for placement of multiple cages, light-emitting or reflecting devices, and wind-indicating ribbons to be attached to the station. The support described makes possible deployment of stations over a wider variety of terrains, increasing the extent of field trials. Presentation of the simple design and fabrication of the rotating collection device (impactor), T-station, and its support is provided.

**KEY WORDS** Aerosol sampling, adulticide trial, droplet collection, mosquito-holding cages

The collection of field efficacy data is a major factor in the course of putting novel insecticidal formulations through mandatory protocols. Tests involved in registration of pesticides include quantitative and qualitative droplet collection, meteorological recording, and observations of mortality on caged invertebrates. Pesticide efficacy trials are performed using different chemistries and varying environmental conditions including open fields, wooded areas, and residential situations (Tietze et al. 1996). The adoption of a standard-sized support will ensure meaningful cross-comparisons between trials, as well as allowing use of droplet sampling and wind measurement in conjunction with cage bioassays.

We present a simple and inexpensive design for the Florida Latham Bonds (FLB) rotating impactor (Barber et al. 2005, 2009), accompanying stands (T-station), and a mobile support that secures the poles on any terrain. All materials involved in construction of supports and stations are commonly found in most hardware stores.

*Construction of rotating impactor:* The 6 V DC 60 Hz motor model 3605 with 686 rpm no load (Premotec Ltd., Dordrecht, The Netherlands) costs around $50 and fits into a threaded 1-in. (2.5 cm) schedule 40 polyvinyl chloride (PVC [MT × S]) male adaptor, priced at $1 (Figs. 1B and 2B). This unit is fitted into a 1½-in. (3.7 cm) × 1-in. PVC (S × FT) female reducer bushing with a ¼-in. (0.6 cm) hole ($2). A 1½-in. PVC (S × S) coupling is cemented in place over this bushing ($1). A 5-in. (12.7 cm) section of 1½-in. PVC pipe is then cemented into the coupling, and a ½-in. (1.2 cm) hole is drilled into the pipe to allow fitting of a single-throw subminiature toggle switch ($4). The removable base of the unit is made by cementing a 1½-in. to ¾-in. (1.9 cm) PVC reducing bushing ($3) into a 1½-in. PVC (S × S) coupling ($1). A 3-in. (7.62 cm) length of ¾-in. PVC pipe is cemented into the reducer, which allows the impactor to be fitted into the T-station described below. A guide hole is drilled into the coupling, allowing a #10 ½-in. sheet metal screw to be used to secure the unit and allow battery insertion. Appropriately colored 12 AWG wires ($5 for a 20-ft [6.1 m] length) are pushed through the ¼-in. hole in the PVC bushing, soldered to the terminals on the motor, and taped to the bushing with electrical tape. The positive wire is cut to a length to allow the toggle switch to be soldered. Another length of wire is soldered to the other terminal of the switch. Both this wire and the negative wire are cut to fit the unit and then soldered to the 4 AA battery holder ($2). The rotating section of the device is

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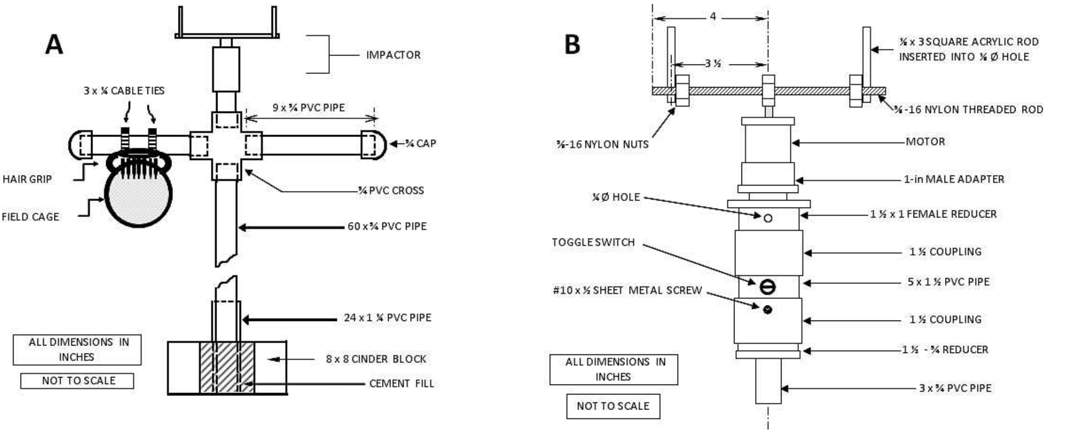


Fig. 1. (A) Schematic drawing of T-station and support for mosquito-holding cages and rotating impactor; (B) schematic drawing of FLB rotating impactor.

fabricated from an 8-in. length of threaded nylon rod ⅜-in.-16 and 3 nuts, ⅜-in.-16 (McMasters Carr, Atlanta, GA), which retails for \$8 per 2 ft (61.0 cm) length and \$8 per 50 nuts. All 3 holes are drilled into this rod via a drill press, using a ⅛-in. (0.3 cm) drill bit. Droplet collection is facilitated by use of 3-in. (7.6 cm) sections of clear extruded ⅛-in. square section acrylic rods ⅛-in. (\$1 for a 6-ft [1.8 m] length), covered on the upper surface with ½-in. (1.3 cm) wide optically clear Teflon coated tape, costing approximately \$35 for a 33 m roll (both McMasters Carr). These rods are made in batches using 1-ft (30.5 cm) lengths of rod, placed side by side with tape applied to the upper surface and cut out using a scalpel. The rods are then cut to 3-in. (7.5 cm) lengths using sharp wire cutters. The rods are best stored and transported to the field in plastic coolers, held within a section of plastic board containing ⅛-in. holes. When deployed, the rods are inserted into the 2 holes in the threaded rod and secured in place using the nuts, with the taped surface facing clockwise.

*T-station:* The lightweight and ubiquitous nature of PVC pipe, its low cost, and high tensile strength commends its use in fabrication of supports for scientific equipment (Condon et al. 2009). In this instance, the droplet sampler and mosquito field cage (Townzen and Natvig 1973) are affixed to a T-station (Figs. 1A and 2A). Designs similar to that presented here have provided support for rotating impactors in both open field and woodland trials (Barber et al. 2007). The support also provides sufficient space for attaching wind-indicating ribbons, light-emitting sticks, and meteorological sampling equipment such as a cup anemometer found in commercially available weather stations. The height of the T-station is sufficient to allow droplet sampling above the influence of ground obstructions but is accessible for field workers.

Total cost of all materials is under \$15 per support, priced on average at 2 nationwide hardware stores. The cost was based on individual item prices with no bulk discounts. The 1¼-in. (3.2 cm) PVC piping for the sleeve was bought at less than \$5 for a 5-ft (1.5 m) length, the ¾-in. (1.9 cm) tubing used for the rest of the project was found for less than \$4 per 5-ft length, the ¾-in. caps cost less than a dollar each, and a 4-way ¾-in. cross-piece was priced at less than \$2. The time and labor involved in the construction of the support and station were minimal, requiring only basic cutting tools such as a hacksaw for the PVC. The PVC pipe has sufficient intrinsic strength so that the T-station can be deployed using only 18-in. (45.7 cm) sections of rebar that have been hammered into the substrate. No permanent fixing by PVC cement of pipe or junction is necessary, which aids off-season storage of equipment.

Equipment such as other types of rotating impactors or anemometers can also be attached to the T-station by fabrication of a simple PVC union or bracket that ends with a 3-in. (7.6 cm) length of ¾-in. PVC pipe. This section of pipe can then be pushed into the top of the PVC cross and provides adequate, nonpermanent support. The Compact Aerosol Droplet Sampler Model 312 (J. W. Hock, Gainesville, FL), can also be used on the T-stations. To achieve this, a length of wooden dowel is inserted into the metal fitting on the sampler. This dowel will then fit into a 3-in. (7.62 cm) long section of ½-in. (1.27 cm) pipe that in turn fits the ¾-in. (1.9 cm) PVC cross.

*Support:* Use of a cinder block provides its own mold for the wet cement, requiring only a drop

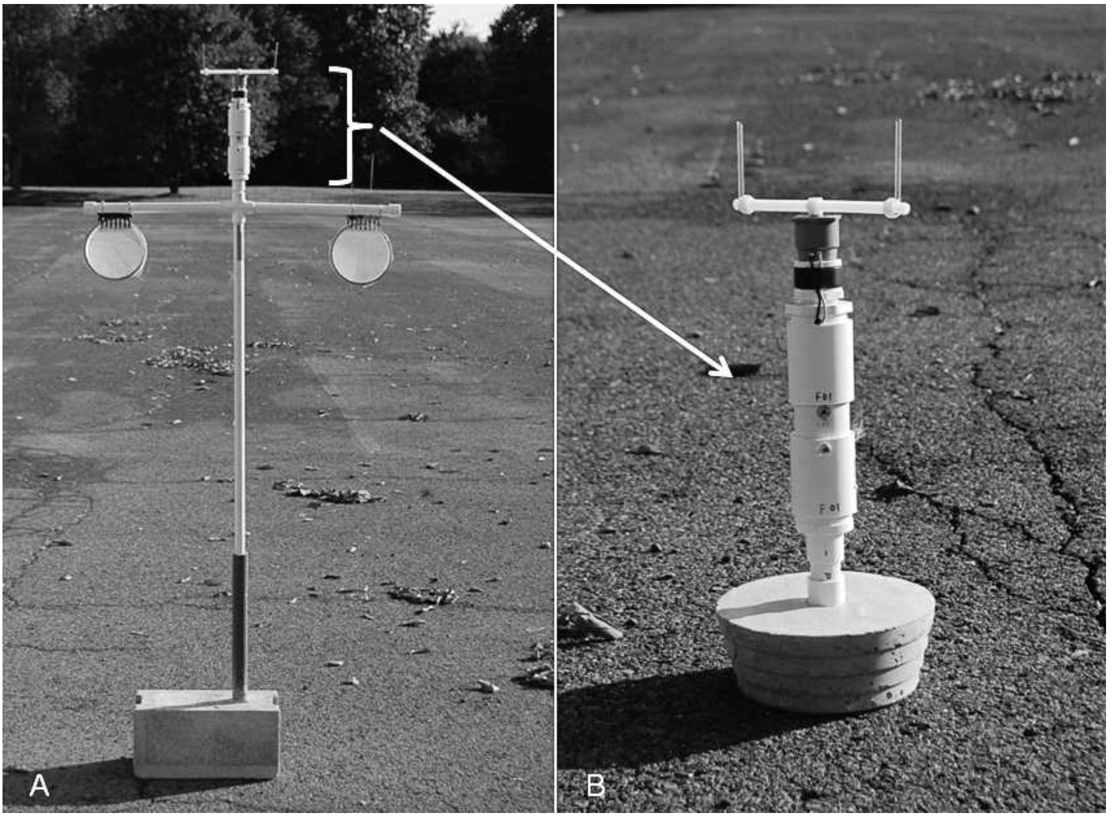


Fig. 2. (A) Support, T-station, and mosquito cage in situ; (B) droplet impinger.

sheet underneath the blocks and a clamp to stabilize the pipe until the cement is set. The 1 ¼-in. (3.17 cm) sleeve tubes are placed in the center of the hole in the block, and the mixed concrete poured into the hole (Fig. 2A). Once the concrete has set and the supports are removed from the drop sheet, they are ready to be deployed in the field. Cinder blocks (8 in. × 8 in. × 16 in. [20.32 cm × 20.32 cm × 40.64 cm]) cost less than $1.50 each; a typical 10-lb (4.5 kg) tub of quick mortar-type concrete costs about $8 and is sufficient fill for one block. Additionally, for placement of rotating impactors near ground level, we used 8-in. (20.0 cm) plastic plant saucers at a cost of $0.50 each (Plastec, Delray Beach, FL) to manufacture a smaller support block. Cement was poured into the saucer molds, and a ¾-in. PVC (S × S) coupling ($1) was placed in the center to allow direct installation of FLB rotating impactors. This smaller design obviates the need for a sleeve to support much heavier T-stations and accompanying apparatus. However, the sleeves used for larger cinder blocks provide stability and act as a spatial locator for members of staff involved in the initial setup of any large-scale experimental grid. From small trials, the sleeve needs to only be 2 ft (0.6 m) in length to form an effective support. This allows the use of off-cut sections that remain from other projects, and this can lower overall costs.

In conjunction with the stand's support of impactors, they are also sufficiently stable to allow the stations to be left overnight for logistic reasons. This also provides an adequate period for decontamination by the sun and or rain after application.

The cinder block support offers a potentially universal means of providing an anchor for these T-stations throughout the USA and abroad. The need for potentially hazardous and time-consuming hammering of sections of corroded rebar into unknown ground types is obviated. More importantly, it permits support placement in any environment, notably on excessively loose or hard substrates such as tarmac, flagstones, and sloping terrains.

The authors would like to thank all those willing participants in such trials for deployment of these stands and for their continued patience when there was no pebble tossed nor wind to blow. We are grateful to Roy Sweeb for advice on the schematics. We thank Henry Rupp for reviewing earlier drafts for the English grammar.

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