NOTE

An Easily Replicated, Inexpensive Malaise-Type Trap Design[1]

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A Malaise trap is a passive flight intercept trap first designed by Rene Malaise in 1937 (Malaise, Entomologisk Tidskrift 58: 148-160, 1937; Gressit and Gressitt, Pacific Insects 4: 87-90, 1962). The design of the trap relies on instinctive insect behavior; strong-flying insects like dipterans and hymenopterans attempt to escape the trap by flying upwards towards light and are collected at the apex of the trap (Townes, Proc. of the Entomol. Soc. Washington 64: 253-262, 1962; Butler, The Pan-Pacific Entomol. 41: 51-53, 1965). Many modifications of the original design have been used for insect sampling (Matthews and Matthews, The Michigan Entomol. 4: 117-122, 1971; Southwood, Chapman & Hall, London, 524 pp., 1978). Most of these models are stand-alone sampling units for insect species diversity assessments. Malaise traps are increasingly popular among taxonomists but are uncommon among other insect monitoring researchers (Matthews and Matthews 1971). The major obstacles limiting use in other types of insect monitoring are cost and complexity of construction (Butler, The Pan-Pacific Entomol. 41: 51-53, 1965). The Townes design (Townes 1962; Townes, Entomol. News 83: 239-247, 1972) best approximate the structure desired for our field work, but due to their complexity (Southwood 1978), further modifications were made for our studies reported here. Our objective was to design an inexpensive, compact, portable, and easily replicated Malaise-type trap that could be easily replicated for monitoring the effects of buckwheat (*Fagopyrum esculentum* Moench) border habitats on natural enemy insects of cucumber beetles [*Acalymma vittatum* Fab. and *Diabrotica undecimpunctata howardi* Barber (Coleoptera: Chrysomelidae)] within a squash (*Cucurbita pepo* L. 'Seneca Prolific') agroecosystem.

Our design was a wood frame of three legs attached together in tripod form by a bolt and wing nut (Fig. 1). Two of the legs were 1.22 m long and the third leg was 1.83

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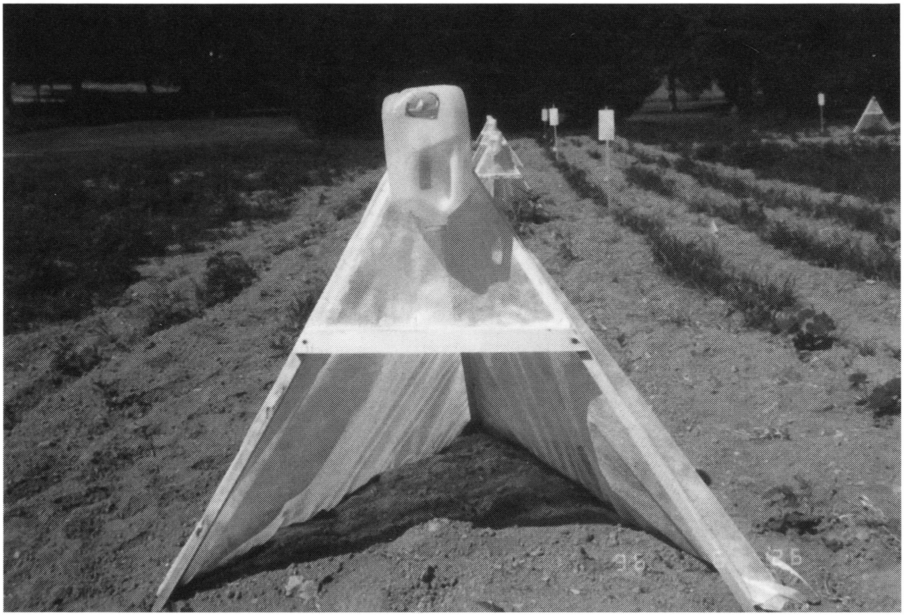

Fig. 1. Front view photograph of easily replicated, inexpensive Malaise-type trap used to monitor natural enemies of cucumber beetles.

m long. The two shorter legs formed a vertical triangle at the front of the trap, and this was supported by the longer leg extending down to the soil towards the back. For additional support, a 0.52-m crossbeam was attached between the two front legs with #6, 4.10 cm drywall screws, 0.45 m down from the top. Spunbonded polyester (Reemay®, Reemay, Inc., Old Hickory, TN) netting was attached by staples and covered both sides extending down from the longer leg to the soil, with edges buried in the soil. The front above the cross beam was also covered with netting, so that escape by insects as they moved upwards would be blocked. All areas except the opening below the cross beam were thus covered. The opening for insect entry was 0.52 m^2 in area.

Insects were collected in 3.78-L plastic milk jugs placed upside down at the apex of the trap. A hole was cut out at the top of the jug and PVC pipe (6.35 cm diam × 0.127 m length) was attached to serve as a conduit from the apex of interior of the polyester-covered trap to the collection jug (Fig. 2). PVC pipes were secured into the apex of traps with duct tape. As suggested by Townes (1972), Vapona (Hercon® Vaportape ™ II, Hercon Environmental through Gemplers, Mt. Horeb, WI) strips were used as killing agents. Strips were hung from hooks inside the collection jugs. To empty the jugs, the milk cap was removed and insects that had settled on the cap and around the base were removed and put into a 70% ethanol + 1.4% glycerin mixture. A 2 mm long slit was cut in the caps to allow for water drainage. The slit was too small to allow insects to wash through. We found that collecting on wet days or mornings with heavy dew was difficult because the insects adhered to the plastic jug. Collection was easiest on dry days.

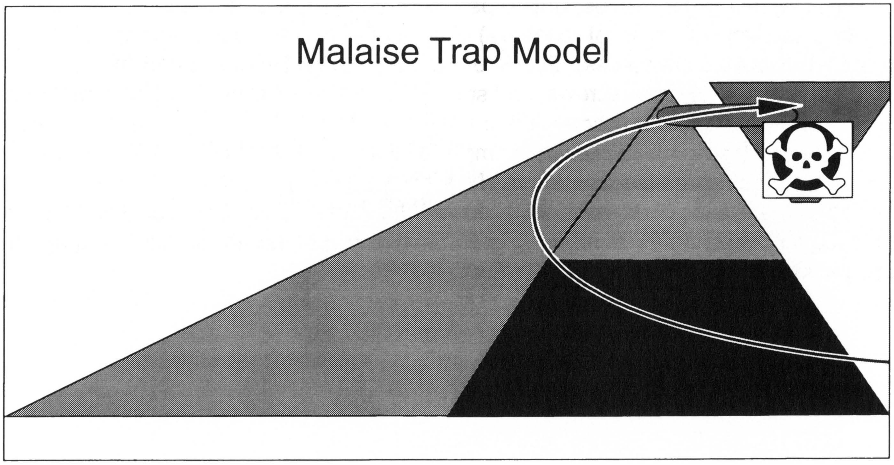

Fig. 2. Side view diagram of inexpensive Malaise-type trap showing how insects are captured in the collection jug after entering the conduit at the apex in their attempt to escape the trap by flying upward.

On 26 June 1996, 20 Malaise traps were placed in four replications within a 25.6 m × 42.7 m squash planting. In each replication, five traps were spaced on transects at 0 m, 9 m, 18 m, 27 m, and 36 m from the floral border of buckwheat. All traps were placed so that trap openings faced the buckwheat border to capture insects dispersing from the border down the crop row. Samples were collected from the jugs weekly starting on 1 July and ending 29 August, for a total of nine sampling dates. No traps had to be replaced during sampling and holes in the netting were patched with duct tape as needed.

For the first sampling date on 1 July, all insects captured were sorted and counted to order. The total counts from all 20 traps on this date were 242 Diptera, 302 Homoptera, 71 Hymenoptera, 17 Coleoptera, 7 Lepidoptera, and 5 Hemiptera. The Diptera included 13 *Celatoria diabroticae* and *C. setosa.* Abundant catches of Homoptera were also noted by Gressitt and Gressitt (1962), but they stated that Homoptera counts varied. Beneficial insects collected included the families Syrphidae and Tachinidae (Diptera) and the superfamilies Chalcidoidea and Ichneumonoidea (Hymenoptera). Bees (Superfamily Apoidea, Hymenoptera) showed high counts in some traps on certain dates, and on 9 July, one trap captured 28 ants (Hymenoptera:Formicidae). Cucumber beetles were found in extremely low numbers (8 over the entire season). This was expected because Coleoptera tend to drop when encountering objects in flight, hence avoiding capture by Malaise traps (Matthews and Matthews, New York Entomol. Soc. 78: 52-59, 1970; Southwood 1978). Other orders that were collected in low numbers (below 10 insects for the season) included Dermaptera, Neuroptera, and Orthoptera.

This modified Malaise-type trap design might be useful for insect monitoring in other field experiments due to its simple construction. Advantages of this design include: (1) readily available, sturdy materials for construction including wood, PVC pipe, plastic milk jugs, staples, duct tape, and spunbonded polyester netting that all last for a season with minimal repair; (2) low cost ($5.15 per trap) of materials [$1.78 for wood (two 40.6 cm pieces), $0.48 for spunbonded polyester (2.815 m^2 at $0.17 m^{-2}), $0.45 for bolts, nuts, screws, and staples, $0.19 for PVC pipe (0.127 m at $1.47 m^{-1}), and $2.25 for the Vapona strip]; (3) ease of transportation, installation, and removal from the field provided by compact, light-weight (1.8 kg), folding wood tripods; (4) durable installation in the field because tripod legs can be set firmly in the ground and excess netting covered with soil; (5) simple insect collection provided by a plastic milk jug placed at the apex of the trap and an easy-to-handle killing agent using a wide-spectrum insecticide that lasts for 3 months.