# AN ADJUSTABLE WATER-PAN TRAP FOR SIMULTANEOUS SAMPLING OF INSECTS AT DIFFERENT HEIGHTS

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ABSTRACT

An inexpensive, easy to install, adjustable water-pan trap was developed and used to simultaneously monitor aphids and cicadellids at three different heights in a maize-bean-pumpkin triculture. The trap can be adjusted to any desired height up to 2.2 m. The results suggest that insect activity (as reflected in trap catches) varies with height. In contrast, use of other traps which sample at one height may underestimate insect populations providing a biased or limited representation of their true abundance.

RESUMEN

Una trampa ajustable de bajo costo y fácil de instalar, fue diseñada para el muestreo simultáneo del áfidos y cicadélidos a tres alturas distintas en un policultivo de maíz-frijol-calabaza. La altura de cada trampa puede ser ajustada hasta una altura máxima de 2.2 metros. Los resultados obtenidos sugieren que la actividad de los insectos (según se refleja en las capturas) varia con la altura a la cual se colocó la trampa. El uso de trampas que se colocan a una altura específica podría desestimar las poblaciones de insectos resultando en una representación limitada o parcializada de su abundancia real.

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Many devices such as the suction trap (Johnson 1950), the rotary or whirligig trap (Irwin 1980), and the water-pan trap (Taylor & Palmer 1972) have been used to sample insects in the field (Southwood 1978). These traps are usually set at a specific height above ground level and thus, sampling only reflects the abundance of insects at a specific aerial stratum. These estimates of abundance may not accurately reflect the relative abundance of the insect nor its vertical distribution.

Given that, in general, insect density decreases as height increases (Johnson 1957, Taylor 1960), the placement of a single trap can bias estimates of abundance or density. Microclimate differs significantly at different heights (Geiger 1971), and an interaction between microclimate, vertical insect distribution, and vegetation is probable. Knowledge of the vertical activity, abundance, and distribution of a pest insect thus could be critical in a pest management program because sampling could be done in a stratum where insect activity is not representative.

Of the traps mentioned above, suction traps act non-selectively, i.e., neither attracting nor repelling insects (Heathcote 1957, Taylor 1962) but their requirement for electric power and their high cost are major drawbacks (Heathcote 1957). In contrast, although water-pan traps are usually yellow and, therefore, attract many insects (Eastop 1955, Kisimoto 1968, Landis 1972, Taylor & Palmer 1972, Capinera & Walmsley 1978) they are inexpensive, easy to handle, may be used during rainfall and, maintain captured insects in good condition (Kisimoto 1968) and thus is often the trap used in field studies.

The goal of this study was to monitor aphid and cicadellid activity simultaneously using an adjustable device to support three pan traps at three different heights. We chose to concentrate our efforts on sampling these two types of insects because of their economic importance.

## Materials and Methods

Trap preparation. Two 2.5 m long, 1.5 cm thick, and 3.5 cm wide wood strips were nailed to each other with a 1 cm thick, 10 cm long wooden spacer between them at each end to provide a gap into which three sliding trays were inserted (Fig. 1). Yellow pans 14.5 cm in diameter and 3.5 cm deep were placed on each tray. Total cost for materials to build one trap was approximately $4.00.

Field evaluation. Insect captures were made at the Campo Experimental of the Colegio de Postgraduados in Montecillos, México (2250 m above sea level, 19° 26′ 46″ latitude, 98° 51′ longitude). A yellow pan containing soapy water was placed on each sliding tray set 0.20 m, 1.3 m, and 2.2 m above the ground in the middle of three maize-bean-pumpkin plots (13 m by 15 m), when plants were in the seedling stage. Samples were collected at 1300 hours (24 hours after the pans were initially set up) on 21 and 28-IX-1988 and on 6-X-1988. Therefore, for each sampling date there were 3 replicates at each height.

Statistical analyses. Data were analyzed as split-plot repeated measures design with treatment (height) as the main plot factor and sampling date as the subplot factor. To meet the assumptions of homogeneity of variances we transformed the raw data to natural log (adding a constant of 10 to the raw data). We used ANOVA to test the effect of sampling height on insect capture numbers (GLM, SAS Institute Inc. 1985). When ANOVA found significant differences, we used Bonferroni's t-test to determine differences between treatment means (SAS Institute Inc. 1985).

## Results and Discussion

About 99% of the aphids collected were the corn leaf aphid *Rhopalosiphum maidis* (Fitch), whereas the cicadellids consisted of *Dalbulus maidis* (DeLong & Wolcott) and *Dalbulus elimatus* (Ball). The traps also collected dipterans (e.g., Anthomyiidae, Dolicopodidae, Muscidae, and Sciaridae), hymenopterans (mostly Braconidae), and coleopterans (Cantharidae, Coccinellidae, Chrysomelidae, Curculionidae, Scarabaeidae, and Staphylinidae)

There was a significant interaction between sampling dates and sampling heights (for aphids: $F = 6.83$; $df = 4$; $P < 0.05$; for cicadellids: $F = 30.43$; $df = 4$; $P < 0.0001$). On the first two sampling dates there were more insects in the lowest pan traps (0.2 m) but by the 3rd sampling date, this trend was reversed and most insects collected (68% of the aphids and 86% of the cicadellids) were in the highest trap (Table 1). These results could, in part, be due to changes in wind velocity and direction, precipitation, solar radiation, or humidity. However, as Johnson (1957) has pointed out, ". . . . the numbers (of insects) at a given altitude depend also on the way in which the aerial population is distributed between various heights, and this is largely a matter of atmospheric stability and not easily expressed in terms of temperature, humidity, or wind at any particular height".

The shifts in vertical distribution of aphids and cicadellids noted in our sampling results would not have been noticed if sampling had been done at only one height, as it is usually done. This could be critical in pest management programs because single trap sampling could underestimate pest insect abundance. For example, if we had used aphid or cicadellid numbers from the lowest trap on the latter two dates (Table 1), we might have assumed that abundance was decreasing as the season progressed. In contrast,

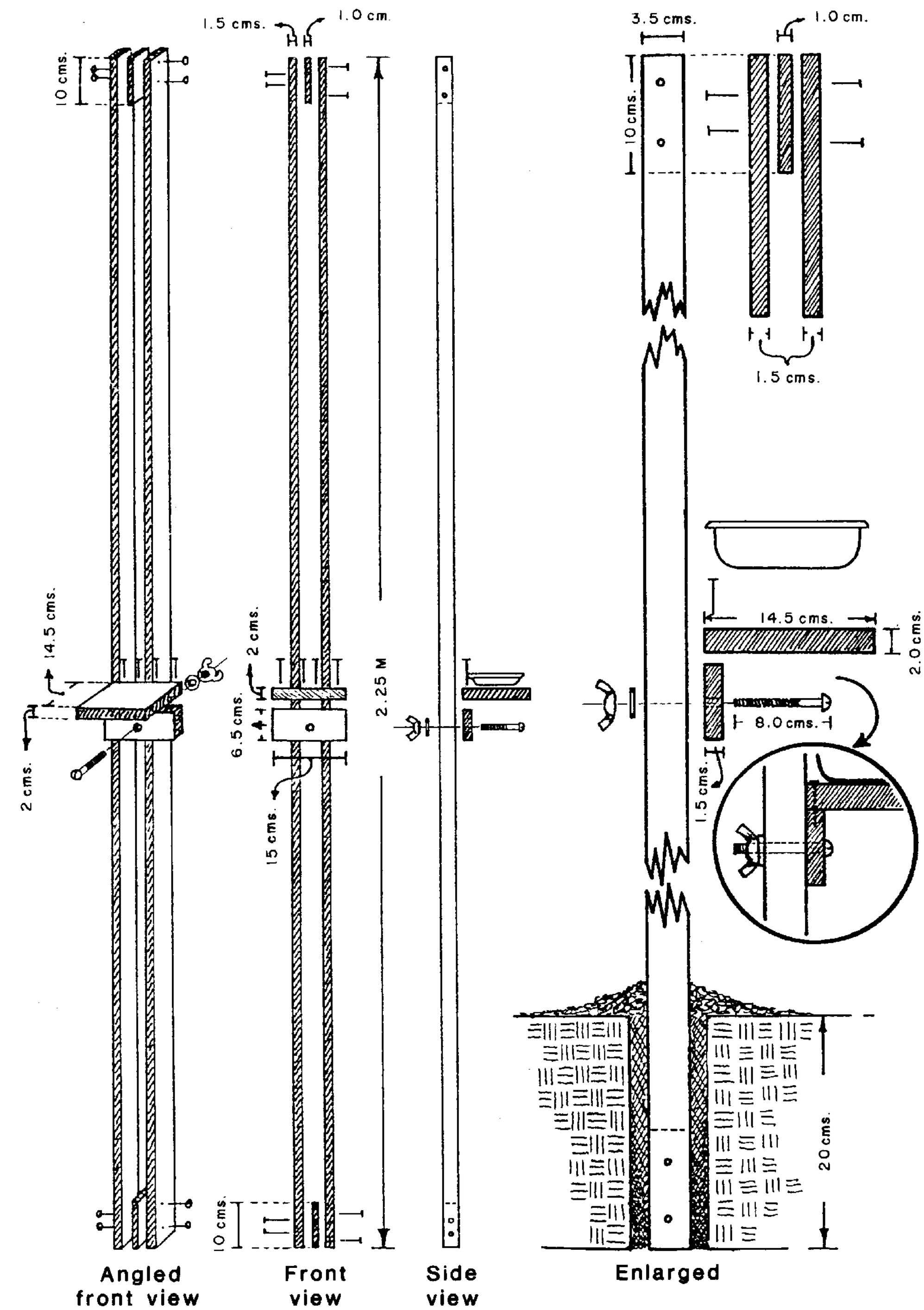


Fig. 1. Design for the adjustable height pan trap.

had sampling been done only at the highest level, the opposite conclusion would have been made. Obviously, sampling at only slightly different elevations above the ground may give dramatically different estimates of insect population sizes.

TABLE 1. DIFFERENCES IN APHIDS AND CICADELLIDS CAPTURED[1] AT THREE HEIGHTS AND ON THREE DIFFERENT DATES.

| Height (m) | Aphididae | | | Cicadellidae | | |
|---|---|---|---|---|---|---|
| | Sept. 21 | Sept. 28 | Oct. 6 | Sept. 21 | Sept. 28 | Oct. 6 |
| 0.20 | 251.3 a[1] | 12.0 a | 3.0 b | 10.0 a | 20.0 a | 0 b |
| 1.3 | 134.0 b | 2.0 b | 2.3 b | 2.0 b | 1.7 b | 0.7 b |
| 2.2 | 122.7 b | 3.0 b | 11.3 a | 1.0 b | 0 b | 4.3 a |

[1]Analysis was done on natural log transformations. Means in Table 1 are untransformed data. Means within a date followed by the same letter are not significantly different (Bonferroni's t-test, $p<.05$).

Use of variable height traps allows sampling at different heights enabling researchers to monitor vertical abundance and distribution of insects, as well as related phenomena such as arrival times or changes in seasonal abundance. At periods of low insect density, multiple traps might be more efficient in detecting insect presence than a single trap at a specific height.

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# MORTALITY OF CARIBBEAN FRUIT FLY IMMATURES IN SHRINKWRAPPED GRAPEFRUIT

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ABSTRACT

Film wraps (Clysar EHC-50-F, 12.7 µ and Clysar EHC-150-F, 39 µ) applied with heat to seal individual Florida 'Marsh' grapefruit, *Citrus paradisi* Macf. were tested as a possible quarantine treatment against Caribbean fruit fly, *Anastrepha suspensa* (Loew) infestations. The number of surviving pupae decreased when grapefruits infested with eggs and larvae 1 to 2 and 8 days old were wrapped for 7 to 35 days. Probit 9 (99.9968%) mortality was not achieved. The wraps were not effective barriers because mature larvae survived and then escaped from inside individually wrapped grapefruits and pupated. Clysar film wraps (EHC-50-F and EHC-150-F) are not recommended as a quarantine treatment against Caribbean fruit fly infestations in grapefruit.

RESUMEN

Se probaron materiales envolventes (Clysar EHC-50-F, 12.7 µ y Clysar EHC-150-F, 39 µ) aplicados con calor para sellar individualmente toronjas Florida 'Marsh', *Citrus paradisi* Macf., como posible tratamiento de cuarentena contra infestaciones de la mosca de frutas del Caribe, *Anastrepha suspensa* (Loew). El número de pupas sobrevivientes disminuyó cuando las toronjas infestadas con huevos y larvas de 1 a 2 y de 8 días de edad fueron envueltas de 7 a 35 días. No se obtuvo mortandad de probit 9 (99.9968%). La envoltura no fue una barrera eficaz puesto que larvas maduras sobrevivieron y se escaparon de las toronjas envueltas individualmente y puparon. No se recomienda usar envolturas de Clysar (EHC-50-F y EHC-150-F) como un tratamiento de cuarentena contra infestaciones de moscas del Caribe en toronjas.

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Fruits and vegetables can be individually sealed in heat shrinkable film wraps as a postharvest treatment primarily to reduce decay (Risse et al. 1985 a,b), alleviate chilling injury (McDonald 1986, Miller & Risse 1986, Wardowski et al. 1973), and extend shelf life (Ben-Yehoshua 1985, Delate et al. 1985, Miller et al. 1986 a,b). Shetty et al. (1989) wrapped papayas, *Carica papaya* L., in film as a postharvest quarantine treatment to kill egg and larval infestations of oriental fruit fly, *Dacus dorsalis* Hendel, and reported