# Low-cost wind tunnel for micro-arthropods

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The aerial transport of tiny arthropods including wing-less species has been well documented. The initiation of aerial dispersal in most instances is not a passive phenomenon, but involves identifiable behaviors in response to specific stimuli. Here we describe a construction of wind tunnel suitable for close-up observation of micro-arthropods behavior under various conditions. The tunnel was made of glass with inner dimensions 6x6x110 centimeters. Both the inlet and outlet compartments were equipped with an electric fan, series of plastic diffusers and a metal mesh to minimize wind turbulence inside a 40 centimeters-long observation chamber in the middle of the tunnel. Wind speed is controlled by changing voltage on a variable AC/DC transformer and actual speed is monitored using a precise TESTO hot-ball anemometer. The object is observed using dissection microscope and The Observer software.

## Introduction

A wind tunnel is a tool often used in chemical ecology experiments with flying insects [1-3]. The construction of such tunnel, however, does not allow a close-up observation of tiny species like *Trichogramma* spp. and other minute parasitic wasps or mites. The latter do not have wings but many are known to exhibit dispersal posture and actively take-off in the presence of wind [4]. Commercially available small-scale wind tunnels used for testing aerodynamics of three dimensional models or for calibration of anemometer probes are very expensive and their measuring chambers are usually not suitable for microscope. Therefore we designed and constructed a simple and low-cost wind tunnel which would allow to study the response of micro-arthropods to various conditions like wind speed, temperature, humidity or presence of volatiles. The example of its application in the study of *Aceria carvi* Nal. (Acari: Eriophyidae) dispersal behavior is given.

# Materials and Methods

The wind tunnel is 110 centimeters long and was made of 28 glass plates glued into seven compartments with inner dimensions 6x6 centimeters (see Figure 1). The middle compartment is 40 centimeters long and is used as an observational chamber. For this purpose it has a hole drilled in the middle of bottom plate where object is inserted on a thin glass rod while it can be observed using a dissection microscope placed above the chamber. Compartments are fixed together using sticky tapes and placed on an aluminum support. This allows to take the tunnel apart when necessary (e.g. for cleaning and adding diffusers). Two 6x6 centimeters 12V electric fans fixed at inlet and outlet compartments provide source of wind. They are connected to AC/DC variable voltage transformer. The wind speed can thus be adjusted by changing voltage on the transformer. Several diffusers were tested to minimize wind turbulence inside the observation chamber. Turbulence was measured by a precise TESTO hot-ball anemometer and visualized by smoke.

The tunnel was used to study the effect of wind speed on dispersal behavior of *A. carv*i. Mites used in the experiments were collected from umbel galls sampled in caraway fields. Adult mite was placed into the tunnel and its behavior was recorded for 300 seconds by means of The Observer. The following parameters were calculated from the obtained data: (1) the time from the introduction of the mite to its first dispersal posture and (2) the time to its take-off. For each wind speed, twenty mites were examined.

## Results and Conclusions

No turbulence in the observational chamber was measured when three plastic honeycomb-like diffusers and one metal mesh were inserted on both sides of the tunnel. Under this setup the wind speed could be precisely adjusted within a range between 0 and 3 m/s. Wind-tunnel experiments with *A. carvi* showed that a dispersal posture occurred at all used wind speeds but no mites took off at speed of 0.5 m/s. Speed of 1 m/s was high enough to enable aerial dispersal in some mites (see Figure 2). Time to mite dispersal behavior and take-off decreased as wind speed increased.

We can conclude that the wind tunnel described above can be build easily and with small costs while its parameters are good enough for precise control of wind speed. The tunnel is suitable for various experiments with small arthropods which need to be observed using microscope. Digital high-speed video camera mounted on the microscope will further enhance it with the possibility to capture and analyze fast movement behavior.

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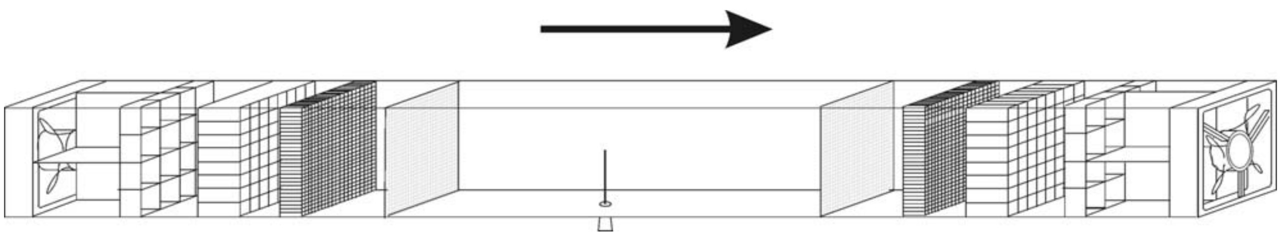

***Figure 1.*** *Schema of the wind tunnel. Arrow indicates the direction of air flow.*

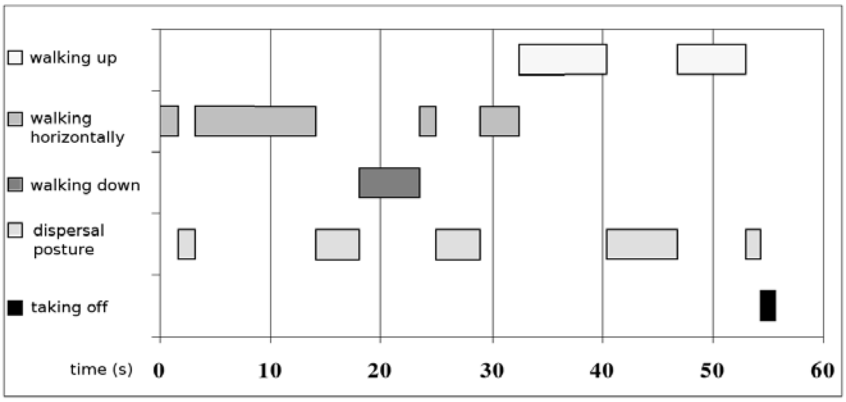


***Figure 2.*** *Time-event plot of* Aceria carvi *behavior. The first three tracks at top indicate time when mite walked up, horizontally or down the glass rod, respectively. Dispersal posture is defined as state when mite stands up on its caudal suckers while moving its legs rapidly. The last track indicates time when mite was dislodged from the glass rod.*

## References

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