An Examination of Whitefly Flight

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ABSTRACT

A series of experiments are being conducted which examine how whiteflies accomplish flight. These are important because knowledge of how insects move may eventually lead to appropriate management strategies for migrating populations.

INTRODUCTION

In a study conducted in 1984, we found that cylindrical traps not only caught the most whiteflies, but also that the numbers captured by these traps were most closely correlated with field populations. A second finding from that study indicated that 82% of the whiteflies were caught at ground level, while only 11% were caught in traps placed at 20 inches and 7% were caught in traps placed at 40 inches.

The discovery that whiteflies fly close to the ground opened up an interesting avenue of research. The fact that 81% of the whiteflies were captured in ground-level traps indicated that their flying habits might be different from those of the aphids which are known to fly at greater heights. This indicated that assumptions concerning whitefly flight, based on what is known about aphid flight, might be incorrect.

To determine if whiteflies and aphids fly differently, we wanted to compare certain properties of selected members of the two families. The variables which were examined were those which are commonly associated with insect flight. These are wingbeat frequency and a parameter called wing loading. The latter is merely the ratio of the weight of the animal to the wing surface area. This gives an indication of lift requirements for each wing.

RESULTS

We found that aphids are significantly larger than whiteflies with body weights ranging from 114 to 702 micrograms. Whiteflies were found to weigh from 33 to 80 micrograms. We also found that aphids had small wings in relation to their weights, so that their wing loadings were twice those of whiteflies. Members of the two families could also be separated on the basis of wingbeat frequency. Aphids have significantly lower wingbeat frequencies than whiteflies, with a range of from 81 to 123 Hz (i.e. times per sec.), while whitefly wingbeat frequencies ranged from 166 to 224 Hz.

This evidence clearly indicates that aphids and whiteflies fly differently. We are using this information, which indicates that whiteflies are poor fliers, to develop a management strategy for the control of whiteflies on vegetable crops. Growers in Arizona are currently left with only one strategy when controlling whiteflies, that is, the direct application of pesticides.

Cotton is a dominant crop in much of the Southwest. Even though whiteflies are rarely a pest on this crop, it appears that cotton serves as a principal source of whiteflies at a time when vegetables are particularly vulnerable to attack. For this reason, an alternative strategy allows vegetable growers to utilize pesticides more effectively. This alternative uses preventive management concepts, where populations of whiteflies are controlled prior to their invasion of vegetable crops.

We are trying to establish whether or not control of whiteflies in cotton has an effect on the ultimate size of the vector populations available to migrate in the fall. We are also trying to determine the critical spatial relationships between cotton fields and surrounding vegetable fields. How far away does a cotton field have to be before it can be dismissed as a source of whiteflies for a particular vegetable field?

The first of these problems is relatively easy to address. It is a matter of reducing whitefly populations in cotton fields in advance of their mass migrations that are thought to occur in the fall following chemical termination of cotton. This can be done using a regime of pesticide applications, while at the same time monitoring whitefly populations.

The second question is more difficult to address as it requires an exact knowledge of whitefly dispersal and migrational patterns between crops. A common method used in the study of insect movement has been to mark individuals in some fashion and then recapture them at another time and location. Because of the small size of many insect pests, including whiteflies, marking techniques such as partial mutilation, paints and dyes are often inappropriate. Mutilating the animals in this way likely has an affect on their ability to migrate, as well as other behavioral patterns.

We intend to label insects with chemical tracers. With other insects, rare earth elements have been used as labels. Their scarcity in the environment insures that insects will naturally have low levels of these elements relative to those individuals which have been artificially labelled. We intend to use dysprosium as our label to assist us in the monitoring of whitefly movement. They will be "marked" in cotton fields and recaptured in vegetable fields. Whiteflies will be identified using a technique called neutron activation.