Sampling Schemes and Action Thresholds for Sweet Potato Whitefly Management in Spring Melons

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Abstract

Early season infestations of sweet potato whiteflies, Bemisia tabaci *(Gennadius) were monitored in fields of cantaloupe,* Cucumis melo *L., near Yuma, Arizona. We used these data to describe the relationship between the proportion of infested leaves and mean adult population density for the entire field. This model was used to develop a binomial sampling plan based on a presence-absence approach. We evaluated the model with three independent data sets, and the level of agreement between the model and data was reasonable for pest management purposes. A minimum sample size of 200 leaves is suggested for maximum accuracy. By turning over 50 leaves in the four quadrants of a field and determining what proportion have whiteflies (i.e., are there whitefly adults on the leaf or not), growers can estimate field populations. We recommend that if 60% of the sampled leaves have whiteflies then it is time to make a pesticide application because that tells you that population levels are approaching 3 adults per leaf.*

Introduction

Despite the economical importance of sweet potato whiteflies, *Bemisia tabaci* (Gennadius), reliable sampling strategies for estimating damage and control thresholds have not been previously available. Considering the damage done by the sweet potato whitefly, assessment of population densities is particularly important in determining the necessity of control methods. Densities of adult whiteflies are often estimated by sticky traps, whereas egg and nymph densities are estimated by counts from leaf areas. However, sticky trap samples are highly affected by weather, trap characteristics and surrounding vegetation. Sampling eggs and nymphs provide a more reliable estimate of whitefly populations, but counting immature stages is a time-consuming and tedious task, especially when whitefly densities can exceed thousands of individuals per leaf. As whiteflies exhibit an aggregated distribution, the high precision pursued by counting whiteflies is offset by the low number of samples that can be processed. Thus, none of those methods provide an adequate balance between reliability and costs, the primary factors for selecting a sampling method.

Cantaloupes, *Cucumis melo* L., comprise about 11% of the vegetable crop area in Arizona. Yields of this crop and fruit quality are often reduced by whitefly populaitons. Considering the relatively low whitefly populations on cantaloupes during early season, binomial sampling may be a suitable option to complete counts because it is easier and faster. The method is based on the relationship between the population density and the proportion of sampling units (here leaves) containing a given number of individuals. In this study, we proposed a binomial sampling plan that can be used to quickly estimate whitefly population densities.

Materials and Methods

Sweet potato whiteflies were sampled from three cantaloupe fields from 3 April to 30 May 1992. Cantaloupes, cultivar 'Topmark', were planted in late January (Field #1) and late February (Field #2). Crops consisted of single rows (80 inches wide) of plants thinned to 12 inch intervals. Crop maintenance followed local agronomic practices. Two applications of oxydemeton-methyl and endosulfan were made before bloom to control aphids at Field #2. Field 1 (6.2 acres), Field 2 (10.4 acres) and Field 3 (16 acres) were divided respectively into six, eight and eight plots of approximately equal size. Weekly sampling was initiated at bloom, a period that coincided with consistent captures of whiteflies on sticky traps, and was conducted for a seven-week period. A systematic pattern was used to sample one plant at a fixed interval of five steps across rows, for a total of twenty plants per plot. On each sampling date, two leaves (terminal and crown sections) per plant were searched for whiteflies. Leaves were carefully turned, and the number of whiteflies on the underside was counted. As whiteflies were counted on leaves far apart within plants, it was reasonable to assume that individual leaves represent discrete habitats and therefore are suitable sampling units. Because preliminary analyses indicated no significant differences between fields, data for all fields were combined, and means were calculated for each plot in each date.

Results

The data used to generate the empirical model had mean densities ranging from 0.03 to 85.9 whiteflies per infested leaf. The empirical model used to describe the relationship between proportion of infested leaves and observed means was statistically significant On the basis of the model a binomial sampling plan for the presence-absence of whiteflies are presented in Table 1. The 34 means and corresponding proportions of the validation data sets were compared with the predicted results from the model. The model was accurate to predict means for proportions < 0.6; above that value, some results were overestimated (Fig. 1).

Important Considerations When Using This Model

- Experimental evidence to date indicates that whitefly populations are relatively evenly distributed in melon fields
- Whitefly adults aggregate on the plant terminals (i.e., distally from the fourth node)
- You should sample adults during early morning hours (within 2 h of sunrise) by carefully turning leaves before adults are active

To prevent problems at harvest, it is necessary to minimize the establishment of whitefly colonies. Failure to do so may result in significant yield loss due to delayed maturity, and reduced fruit size and quality. Whiteflies colonies have relatively lower densities during the early part of the growing season and if left unchecked, can reach unmanageable levels at harvest. Experimental fields where whitefly populations were not controlled experienced a yield reduction of 52%, a 2% loss in total sugars and 50% of the fruit was excessively sticky.

On the basis of preliminary field data, we recommend that whitefly populations not be allowed to exceed three adults per leaf. The reason for this threshold is the management of adult populations at low levels with foliar insecticide applications. We believe that a control regimen based on this threshold would prevent large numbers of whiteflies from infesting plants later in the season.

Growers need a simple sampling system to accurately time the application of insecticides when action thresholds are met or exceeded. Presence-absence sampling has become very popular in integrated pest management (IPM) programs because this is a convenient method that minimizes the time required for estimating populations. Presence-absence sampling involves counting the number of leaves with one or more whiteflies (i.e., are they there [present] or not [absent]) rather and the total number of whiteflies. The information generated from binomial samples can be linked with the tentative action thresholds for whiteflies on melons.

We have found a consistent relationship between the mean number of adult whiteflies per leaf and the number of leaves with one or more whitefly adults in a 200 leaf sample. For example, having sampled 200 leaves in a field, if 60% of the leaves have at least one adult then the estimated level of infestation for the entire field is three to four whiteflies per leaf. This estimation is based on a 200-leaf sample; reduction of the sample size will reduce the accuracy of the estimation.

On the basis of the action threshold, control measures are suggested if you find 60% or more of your sampled leaves with one or more whitefly adults. The presence-absence sampling scheme for adults should not preclude monitoring the crown portion of the plant for red-eyed nymphs. Presence of these nymphs may indicate that adult numbers may increase rapidly.

Table 1. Mean number of sweet potato whiteflies, *B. tabaci*, per leaf (m) corresponding to the proportion of infested leaves ($P_{(I)}$).

$P_{(I)}$	m
<0.10	<1
0.11 - 0.20	<1
0.21 - 0.30	<1
0.31 - 0.40	<1
0.41 - 0.50	<1 - 1
0.51 - 0.60	1 - 2
0.61 - 0.70	2 - 3
0.71 - 0.80	3 - 4
0.81 - 0.90	4 - 7
>0.90	>7

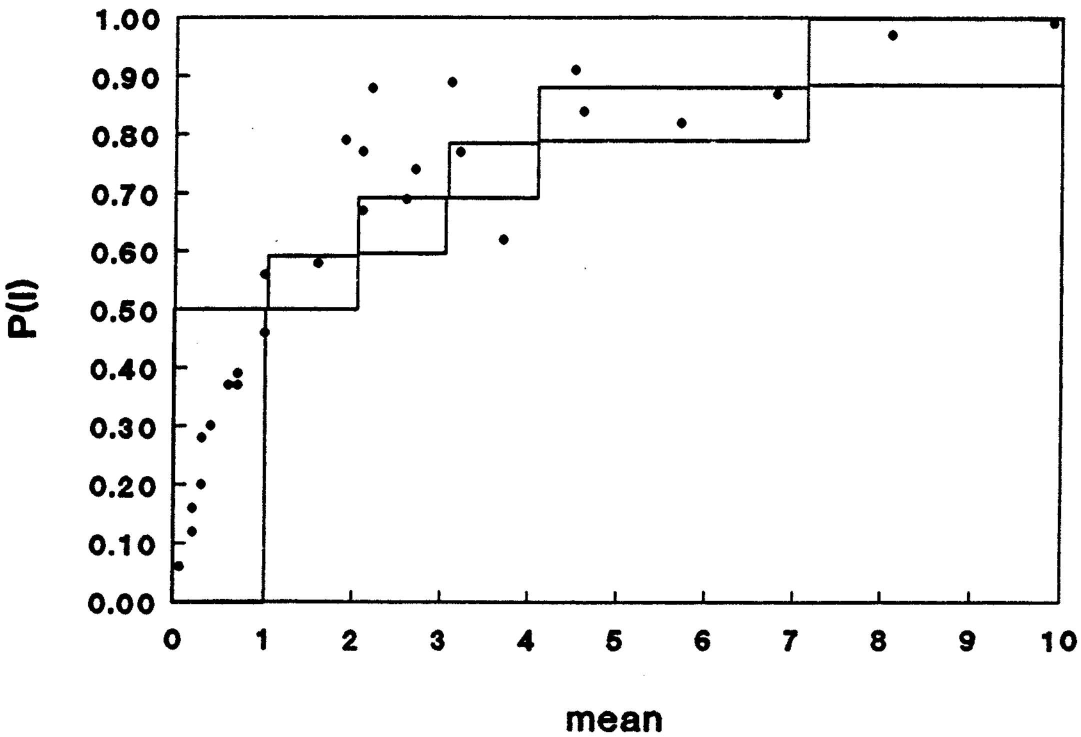

Figure 1. Model validation: area in boxes corresponds to the values of *m* , i.e., predicted mean value for populations on leaves. Scattered dots represent *m* values obtained from the validation data sets.