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Whiteflies In Arizona: Binomial Sampling of Nymphs

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Careful monitoring of pest density for timing control is a key to whitefly management. Since 1994, Arizona cotton pest managers have used a 'leaf-turn' method for sampling whitefly adults (see IPM Series No. 2). This method for sampling adult whiteflies has been extensively evaluated and is a reliable method for estimating whitefly adult abundance and timing control activities in cotton. Similar sampling plans are available for use in spring melons (see IPM Series No. 1). In 1996, with the introduction of two insect growth regulators for whitefly control in cotton, it became necessary to monitor populations of whitefly nymphs in addition to adults, and a sampling method for nymphs was developed (see IPM Series No. 6). We evaluated this sampling plan for nymphs within a commercial-scale whitefly management trial in 1996. Based on the evaluation, we recommend the use of a binomial (presence/absence) sampling plan which may diminish sampler-to-sampler variation while increasing efficiency and accuracy of decision-making.

Sampling Plans

First, count adult whiteflies on the fifth main stem node leaf down from the terminal of the cotton plant (see IPM Series No. 2). Then, detach the leaf and check for large visible whitefly nymphs within a 3.88 cm^2 (quarter-sized) disk wedged between the central and left-side main veins on the underside of the leaf (Figure 1) (see IPM Series No. 6). This sample unit has been found to be the most accurate and efficient measure of total nymph density. Large nymphs (3^{rd} and 4^{th} instar) appear as flattened, egg-shaped disks or scales. Because only large nymphs visible to the naked eye are counted, this method is "field friendly"; no microscopes or hand lenses are required.

If any large nymphs are present within the sample area (quarter-sized disk), then the leaf is scored as infested.

Sample at least 30 leaves per field, starting no less than 10 rows (or 30 ft) into the field and choosing plants at random. Continue sampling along a zig-zag line moving over several rows and taking 5–10 steps before selecting another plant. Individual plants sampled should be 10–15 feet apart. After sampling 15 plants, move to a new site or quadrant within the field and sample 15 more.

After 30 leaves have been examined, determine the percentage of leaves which were infested with 1 or more large visible nymphs within the disk. The proposed threshold for initiating IGR use in 1996 was 0.5 – 1.0 large nymphs per leaf disk ***and*** 3 – 5 adults per fifth main stem node leaf. There are two changes for 1997: ***1) the new nymphal component of the threshold is 1 large nymph per leaf disk, and 2) this level can be estimated most efficiently by the binomial method where 40% of the disks are infested with large nymphs.***

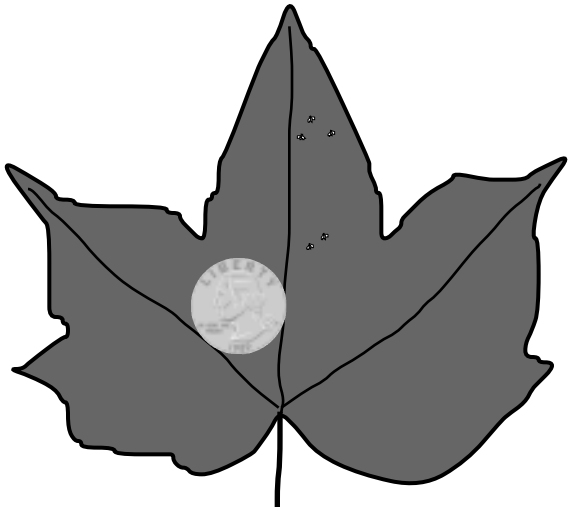

Figure 1: The sample unit for nymphs is a quarter-sized area located between the central and left lateral leaf veins of the fifth main stem leaf below the terminal. Count adults first, detach leaf and determine whether disk area is infested with large, visible nymphs.

Sample Size & Accuracy

Counting nymphs on leaf disks can easily be integrated with adult sampling methods and provides reliable estimates of nymphal whitefly density. A sample size of 30 leaf disks is adequate for estimating moderate densities (≥1/disk)—even more samples are needed to estimate lower nymphal densities (<1/disk) with equal precision. Many samplers expressed a difficulty in distinguishing whether a nymph was "large" (i.e. 3rd or 4th instar) or not. This difficulty was evident in comparisons of counts from the lab under a microscope and the field; lab and field counts of nymphs on the same leaves often differed significantly. Difficulty in detecting and categorizing nymphs correctly was also evidenced by significant sampler-to-sampler variation. In other words, different samplers did not always count the same number of whiteflies on the same leaves.

Why Use the Binomial Method?

Use of a presence/absence, binomial sampling method helps to reduce the potential for error and reduces sampling time, thus increasing sampler efficiency. In particular, a binomial method reduces error in identifying and classifying the sizes of nymphs. Also, binomial samples are not subject to errors in estimating numerical counts of "large" nymphs. Furthermore, in field studies, significant sampler variation resulting from counting all large nymphs became insignificant when samplers had only to determine the presence or absence of large nymphs (Table 1).

Table 1: Sampler variation for numerical counts was significant in (A) where each of four samplers counted all nymphs on 2 sets of 30 disks. In (B) the data were reclassified using the binomial, presence-absence method and sampler variation became insignificant.

A	Numerical Counts		B	Binomial Counts	
Sampler	Rep 1	Rep 2	Sampler	Rep 1	Rep 2
Jon	1.97	0.97	Jon	0.70	0.57
Joan	1.73	2.43	Joan	0.77	0.83
Steve	2.13	3.97	Steve	0.70	0.80
Jan	3.43	2.00	Jan	0.83	0.60
Ave. (±s.d.)	2.32 ± 0.4*	2.34 ± 0.6*	Ave. (±s.d.)	0.75 ± 0.03**	0.70 ± 0.07**

*P=0.0033 **P=0.119

Conclusions

1) These sampling plans are of adequate precision for estimating whitefly nymphal densities in cotton at the levels for which control decisions are critical (≥1/disk). However, do not sample less than 30 leaves; doing so may result in large penalties in precision and inaccurate control decisions.

2) Because sampler error can be significant, scouts should be well trained.

3) Use the presence/absence or binomial sampling plan in place of counting all large nymphs within the disk. ***When 12 out of 30 leaf disks (40%) are infested with one or more large nymphs, the nymphal component of the threshold for IGR use is satisfied.***

4) These binomial plans can help diminish sampler error, reduce the amount of time required for sampling, and provide an accurate means of classifying pest population density.

References

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