Binomial Sampling Plans for Estimating Leafmine Density of *Liriomyza trifolii* (Diptera: Agromyzidae) in Greenhouse Tomatoes: with Analysis on Leafmine Area for Selecting Sample Unit

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The binomial sampling plan for estimating leafmine densities of *Liriomyza trifolii* (Burgess) on tomato leaves was developed using an empirical P_T–m model. An empirical P_T–m model, expressed as: $\ln(m) = \alpha + \beta \ln[-\ln(1-P_T)]$, was used to relate between the proportion of infested leaves (P_T) and mean density (m) at tally thresholds (T, the minimum number of leafmines present before a leaf is considered infested) of 1, 2, 3, 4, and 5 mines per leaf. To ensure the consistent selection of sample units, the area of leafmines was calculated using digital image analysis. The mines > 0.4 cm^2 represented 90.3% of the complete mines measured, and the increase in the number of mines on a leaflet did not affect the area of individual mines. The binomial sampling plans were validated using resampling simulations with seven independent data sets. In an estimation of the density, the sampling precision (SE/mean) was found to increase with higher Ts; however, there were negligible improvements in the precision with $T \geq$ 3 mines per leaf. Using T = 3, over a wide range of mine densities, as few as 30 samples were necessary to achieve a precision of 0.30. Comparing binomial models using T = 3 or T = 5 from seven independent data, the model T = 3 was a robust and relatively unbiased predictor of mean density, whereas T = 5 model was generally biased towards overprediciton of mean density.

Key words: American serpentine leafminer, binomial sampling, tally threshold, resampling simulation, mine area, digital image analysis