Mortality data were analysed and presented in figures based on actual EF concentrations rather than target concentrations. The effect of EF on the mortality of target pests was analysed using a robust version of the Generalized Linear Model (GLM) capabilities (Hastie et al 1992) in R version 3.2.2 (R Core Development Team 2015). Variance was assumed proportional to that for a binomial distribution. The analysis assumed that the form of dependence of mortality on concentration was that given by a complementary-log-log model, with concentration as the explanatory variable.

The assumed form of response was log(-log(1 - p)) = a + bc, where p = expected mortality, and c = concentration of EF.

From the derived coefficients, a and b, the LC99 (calculated lethal concentration) or the concentration of EF required to produce a mortality of 99%, adjustment being made for the control mortality, cm. LC99 is defined as the concentration necessary to achieve a mortality of

cm + (1 - cm) x 0.99.

To determine cm, two possible sources of extraneous mortality were considered: handling and treatment with CO2. The mortality attributed to those sources was compared using a simpler binomial GLM which found one to be significantly higher than the other for some assays and the opposite to be the case for others. To be confident sufficient allowance was made, cm was taken to be whichever was greater. The geometric means of the varying number of replicates for each pest, life stage, fruit (if with fruit) and temperature combination were calculated along with a 95% confidence interval.

LCT99 is simply the LC99 multiplied by the number of hours of exposure to ethyl formate. In some cases, no LC99 was ascertainable but 100% mortality was achieved for some concentrations. Such data points give a less valuable indication of the tolerance to that treatment. A 100% mortality point was considered to be of value only if no higher concentrations produced less than 100% in that assay. In a number of assays, neither an LC99 or a 100% mortality point could be calculated.

LC99s and LCT99s were calculated for insects off fruit and, for some of them, in the presence of fruit. The effect of the presence of fruit on the required concentration is indicated by the difference between the two. For each target concentration (2% or 3%), equations for the lines described by models pertaining to the off-fruit data were used to predict the mortality that would correspond to the range of achieved concentrations for the various replicates. Similar models were calculated for the with fruit data. Predictions were tabulated and compared with the mortalities achieved. Because of the large range of control mortalities, no consistent method of calculating the ’true’ mortality was appropriate. The standard Abbott’s correction is not valid for control mortalities beyond 20% and could not be applied to data that had control mortalities over 75% in some instances. Since the aim was to develop a treatment that could be used commercially, what is important is the combined effect of the carbon dioxide and the ethyl formate, adjustment for control mortality was not appropriate.

For the semi-commercial treatments, only one concentration was used. The mean mortalities and confidence interval were calculated on the complementary log log scale and back-transformed to the percentage scale.

Hastie, T. J. and Pregibon, D. (1992) _Generalized linear models._

Chapter 6 of _Statistical Models in S_ eds J. M. Chambers and T. J. Hastie, Wadsworth & Brooks/Cole.

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