IMPROVING THE ASSESSMENT OF BYSTANDER EXPOSURE TO PESTICIDE SPRAY DRIFT

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INTRODUCTION

The model for bystander and resident exposure to spray drift (BREAM) which is incorporated into current EFSA guidance uses a mechanistic model to predict airborne spray and ground deposits, and an empirical model that relates airborne spray to deposits on the human body, from which dermal exposure can be calculated. EFSA guidance requires that the 75th and 95th percentiles of exposure distributions be used to represent long-term and acute exposures, so it is important that the predicted distributions are comparable with those that might occur in practice. The empirical component, relating field measurements of airborne spray to dermal exposure, has a high level of variability captured within it. This relationship is represented very simply in the BREAM model as a normally-distributed variation around a regression line. The aim of this study was to reduce the resulting unrealistically high values for the higher percentiles by addressing some of the uncertainties in the experimental data and improving the way that the variability inherent in the spray drift process is described in the model.

METHODOLOGY

The empirical data used to relate bystander exposure and airborne spray was reviewed and information relating to the application conditions was included for further analysis. These data comprised nozzle and pressure, sprayer speed, distance downwind, wind speed measured at 2.0 m height above the ground, boom width, crop height, approximate bystander height, and approximate bystander cross-sectional area. In the original model, the only factor that was considered in estimating the relationship between airborne spray and bystander exposure was bystander height. An analysis of both the empirical data and model output distributions was undertaken to investigate the sources of variability. In addition, a wind tunnel study was undertaken to define the collection efficiency of spray droplets under conditions similar to a bystander exposed to spray drift. A new predictive model of the collection efficiency of the human body was developed and incorporated into the BREAM model, denoted BREAM2, together with an improved representation of the variability. A sensitivity analysis to some application and environmental variables was undertaken.

RESULTS

An equation relating Impact parameter for spray droplets to collection efficiency of the human body was defined, based on new wind tunnel data and existing field data. This was incorporated into the BREAM model, and an analysis of outputs compared with field measurements proved that the revised relationship significantly improved predictions of potential dermal exposure. The predicted dermal exposures using EFSA default input values with the original model and the revised version showed that values were reduced by the improved representation of collection efficiency of the human body with, for example, the 95th percentile of adult dermal exposure changing from 1.21 ml spray liquid per person with BREAM to 0.55 ml with BREAM2. Similar reductions occurred for child exposure and at the 75th percentile. A new 'BREAM2' calculator was produced that includes the revised relationship and at the same time addresses some shortcomings in the original BREAM model and the way it has been deployed in EFSA guidance.

DISCUSSION

The sensitivities of the new BREAM2 model outputs to sprayer speed, sprayer volume and spray swath width is explored. This showed that exposure increases linearly up to a spray swath of 100 m, and therefore the default spray swath currently used in EFSA guidance may not represent a worst-case scenario. Boom height is a very important factor in spray drift and the current approach already includes a very conservative estimate. Sprayer speed does not influence exposure at speeds greater than 10 km/h, and therefore where a faster speed is used to reduce applied volume, there is no effect of volume on exposure, suggesting that the EFSA guidance is overly conservative. The comparison between the outputs of BREAM and BREAM2 show that predicted potential dermal exposure should be reduced to provide a more realistic estimate.