NOTES ON THE USE OF THE QMRA − MONTE CARLO PROGRAMS FOR WASTEWATER USE IN AGRICULTURE

QMRA-MC_UnrestrictedIrrigation_Ascaris

Open the program file and click 'enable macros'.[1] There is one sheet: QMRA_BetaP.

Determination of *Ascaris* infection risks

1. The program calculates the median and 95-percentile *Ascaris* infection or disease risks from consuming every *n* days a variable quantity of a root crop eaten raw (e.g., carrots, onions) irrigated with wastewater containing a specified number of *Ascaris* eggs.

2. In the yellow boxes in columns 3 and 4 enter your chosen range of values for:

o   The number *Ascaris* eggs of per litre of (treated) wastewater

o   The volume of wastewater remaining on 100 g of crop after irrigation (ml);

o   The quantity of crop consumed on each occasion (g per day);

o   Consumer exposure − i.e., the consumption of wastewater-irrigated crops every *n* days (enter your value of *n* in both boxes);

o   The variation ($\pm x\%$), if any, to be applied to N_{50} and α;

o   The proportion of exposed consumers who become ill (if this is set to 1, then the program effectively determines the infection risk; if set to <1, then it calculates the disease risk) − enter your value (1 or any value <1) in both boxes; and

o   The number of simulations required (usually 1000 or 10,000).

► Click on any empty cell to confirm your choices.

3. Click the box "Do Monte Carlo Simulation", wait a minute or two, then read the median (50-percentile) and 95-percentile risks of *Ascaris* infection per person per year under "PI Annual" in column 3 (the maximum and minimum risks determined in the MC simulation are also given).

Note A: This program uses the *Ascaris* N_{50} and α values determined by Professor Blanca Jiménez and colleagues[2] in the β-Poisson dose-response equation (859 and 0.104, respectively).

Note B: This program uses the **Benke and Hamilton** method for calculating the annual risk of infection.[3] This method firstly determines an annual risk of infection by doing a Monte Carlo simulation with the number of simulations set equal to the number of days of exposure per year (this is rounded down to an integral value), and it then repeats this to a total of 1000 (or 10,000) times and determines the resulting 50- and 95-percentile annual *Ascaris* infection risks.

Prepared by Duncan Mara, March 2009

[1]In Excel 2007 click on 'Options ...' to the right of 'Security warning. Some active content has been disabled'; then select 'Enable this content' and click on 'OK'.

[2]Navarro I, Jiménez B, Lucario S and Cifuentes E (2009). Application of Helminth ova infection dose curve to estimate the risks associated with biosolid application on soil. *Journal of Water and Health* **7** (1), 31–44; abstract available at: http://dx.doi.org/10.2166/wh.2009.113.

[3]Benke, K. K. and Hamilton, A. J. (2008). Quantitative microbial risk assessment: uncertainty and measures of central tendency for skewed distributions. *Stochastic Environmental Research and Risk Assessment* **22**, 533–539; abstract available at: http://dx.doi.org/10.1007/s00477-007-0171-9.