# Derivation of the mortality rate for two insecticides

Experimental insecticide literature typically specifies the efficacy of an insecticide as an (the dose of insecticide that results in 50% mortality within a given time period) and gradient, describing the linear response between the log of the dose of insecticide applied and the logit of mortality.

We previously showed how to translate the linear relationship between log-dose and logit-mortality into a per-capita mortality rate (Helps et al., 2017). Here we extend this to multiple independent insecticides.

Recapping briefly, with a single insecticide, as the logit of mortality is linear with the logit-mortality we can write:

where is the mortality within a given time period, and the applied insecticide dose, and and are the intercept and gradient of the logit-mortality ~ log-dose relationship. We showed previously that this rearranges to .

Equating this with the proportion of individuals surviving after one day from a population model with starting density and mortality rate , we have:

which can be rearranged for , and since we are looking for the rate of mortality per unit day, the time is removed from the equation.

With two independent insecticides, we have two (potentially different) logit-dose lines, together with their intercepts and gradient, which we denote , , , and for each insecticide. Similarly, and , and denote the mortality and dose for each insecticide respectively.

The proportion of survivors () resulting from two independent mortalities is the product of the survivorship: . Therefore, .

Combining this with Equation 2 gives:

which simplifies to:

## References

Helps, J. C., Paveley, N. D., van den Bosch, F., 2017. Identifying circumstances under which high insecticide dose increases or decreases resistance selection. Journal of Theoretical Biology 428, 153-167, doi:<https://doi.org/10.1016/j.jtbi.2017.06.007>.