WASHINGTON STATE UNIVERSITY

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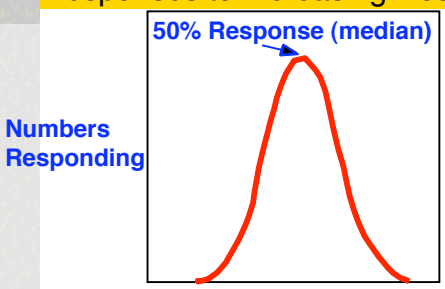
ES/RP 531 Fundamentals of Environmental Toxicology

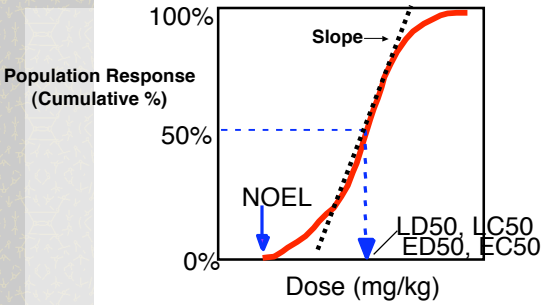
Lecture 6
Dose-Response Relationships

Fall 2005

Distribution of Individual Responses to Increasing Doses

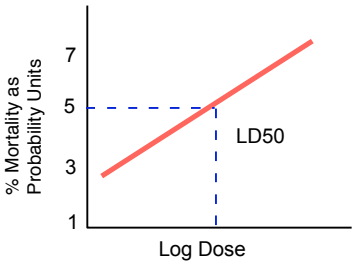


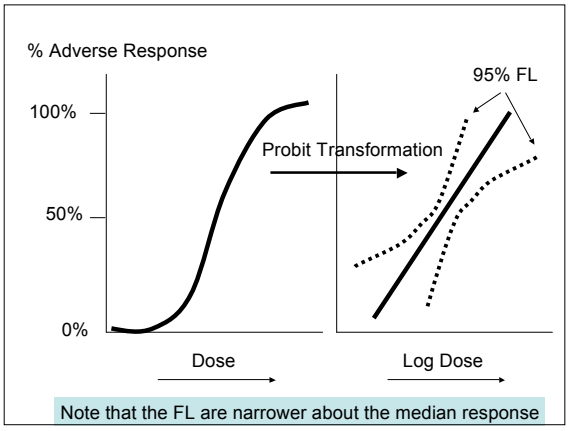
Cumulative Proportion Responding



Linearization of the Dose-Response Curve Using Probit Analysis and Graphing Logarithmic Response

% Mortality	Probit
10	3.72
20	4.16
30	4.48
40	4.75
50	5.00
60	5.25
70	5.52
80	5.84
90	6.28



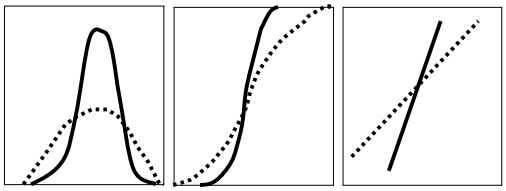


Note that the FL are narrower about the median response

95% Fiducial Limits

- Analogous to the 95% confidence interval (or limits) calculated for univariate statistics
  - If an experiment was conducted 100 times, then the CL or FL represents the distribution of the data (or interval of data) that is predicted to capture the mean (CL) or median (FL) response (or any measured variable) 95 times
  - Thus, there is a 5% chance that the mean or median response was not captured by the estimated interval
  - For any two measured populations, if the estimated 95% FL for the response overlap, then we cannot conclude there is a difference between them with less than 5% probability of Type I error

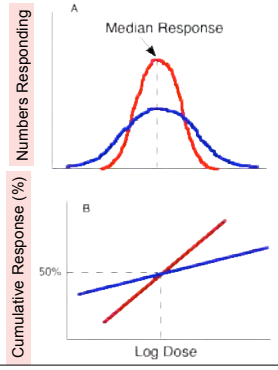
Important Information Contained in the Slope of the Dose-Response Curve



The slope is the key to understanding the variation in population response, and it can be used to compare two or more populations, or alternatively, how different factors affect the response of one population.

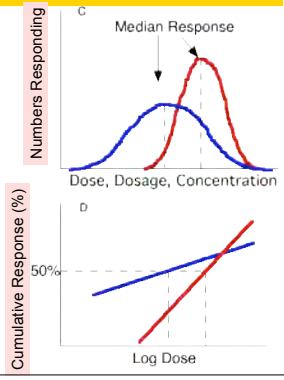
Importance of Slope

- Represents variability in population response
- Characterizes margin of safety
- Response of different species exhibiting same median response to same chemical

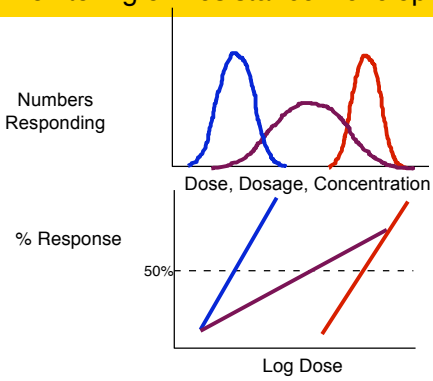


Importance of Slope

- Variation in response of two different species reacting to the same chemical
- Variation in response of single species reacting to two different chemicals

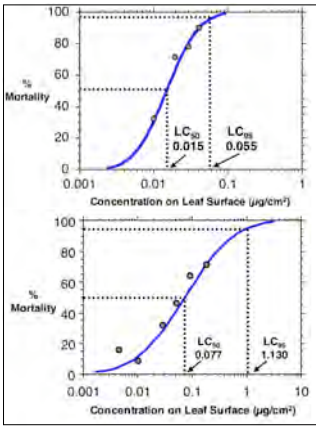


Monitoring of Resistance Development



How Do We Determine the Dose-Response Relationship?

- Example 1: Testing the response of neonate codling moth larvae to different concentrations of insecticides on leaves
  - Treat leaf disks with different concentrations of insecticide solution
  - Expose 5 larvae per leaf in multiple replicate containers
  - Wait specified time period (e.g., 3 h or 24 h) and count total larvae and dead larvae
  - Transform data to % mortality
    - Correct for control (untreated leaves) mortality if necessary

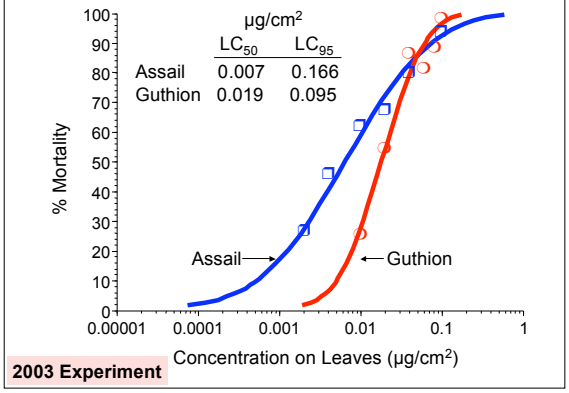


2002 Experiments

Azinphos-methyl Dose-Response

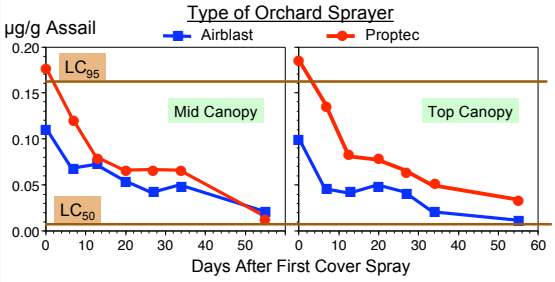
Methoxyfenozide Dose-Response

24-Hour CM Neonate Bioassay: Dose-Response Estimate



Use of Dose-Response Data for Interpreting Environmental Chemistry Data

Recovery of Assail residues and significance relative to dose-response function for neonate codling moths on leaves



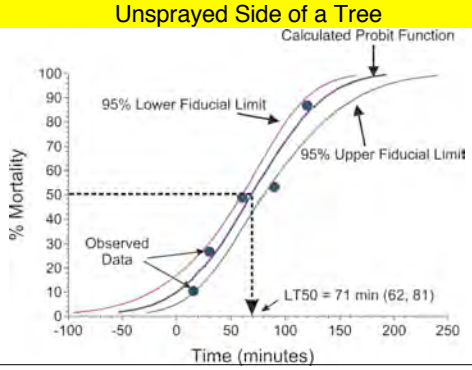
Estimating the Time to Death (or other Response): LT50

- Sometimes we want to know how long it takes or an organism to respond
  - For example, this might be an advantage in pest control
- Take treated leaves (or other environmental samples) and hold larvae on them for specified periods of time
  - If conduct experiment in the lab, you can still use matrices with different concentrations; just vary the time to observation of response at enough intervals to be able to validly estimate a time-response function

Example 2: Time to Die

- How long would it take codling moth larvae to die if exposed to apple leaves directly sprayed or apple leaves from the opposite side of the tree that were not directly sprayed?

Time-Response Function for Neonate CM Larvae Exposed to Apple Leaves Collected from the Unsprayed Side of a Tree



Comparison of Time-Response Functions for Larvae Exposed to Leaves from the Sprayed and Unsprayed Sides of an Apple Tree