**APPENDIX 2-6. Propazine Species Sensitivity Distribution Analysis for Terrestrial Plants**

SSDs were fit to toxicity data for terrestrial plants exposed to propazine. Five distributions were tested and a variety of methods were used to determine whether different subsets of data should be modeled independently. Ultimately, the results from the vegetative vigor and seedling emergence SSDs were used.  **Table 1** provides a summary of the results.

**Table 1. Summary statistics for SSDs fit to propazine test results.**

|  |  |  |
| --- | --- | --- |
| Statistic | Vegetative Vigor | Seedling Emergence |
| Best Distribution (by AICc) | Gumbel | Triangular |
| Goodness of fit P-value | 0.63 | 0.98 |
| CV of the HC05 | 0.33 | 1.266 |
| HC05 | 0.056 | 0.0104 |
| HC10 | 0.070 | 0.0179 |
| HC50 | 0.170 | 0.1818 |
| HC90 | 0.685 | 1.8418 |
| HC95 | 1.167 | 3.1881 |

1. Data

Data used in this analysis are detailed in **Table 11** (at the end of the document) and were from registrant submitted studies; no ECOTOX studies were suitable for inclusion. Eleven species were available from each study. Distributions were created for terrestrial plants based on IC25 values for biomass (height in one species) from seedling emergence and vegetative vigor studies.

Six potential distributions for the propazine data were considered, including log-normal, log-logistic, log-triangular, log-gumbel, Weibull and Burr. To fit each of the first four distributions, the toxicity values were first common log (log10) transformed. Finally, effect thresholds and five quantiles from the fitted SSDs (HC05, HC10, HC50, HC90, HC95) were calculated and reported.

1. Comparison of distributions using AICc

Akaike’s Information Criterion corrected for sample size (AICc) was used to compare the five distributions for the terrestrial plant dataset. For these comparisons all SSDs were fit using maximum likelihood. The AICc suggested that the gumbel distribution provided the best fit for the vegetative vigor data and the triangular distribution provided the best fit for the seedling emergence data (**Tables 3 and 4**).

**Table 3. Comparison of distributions for vegetative vigor toxicity data for propazine.**

| distribution | AICc | ∆AICc | Weight | HC05 |
| --- | --- | --- | --- | --- |
| gumbel | -1.3276 | 0 | 0.5121 | 0.0575 |
| logistic | 0.6445 | 1.9721 | 0.1911 | 0.0378 |
| normal | 1.6585 | 2.9862 | 0.1151 | 0.0381 |
| triangular | 1.9292 | 3.2568 | 0.1005 | 0.0358 |
| burr | 2.6012 | 3.9288 | 0.0718 | 0.0575 |
| weibull | 6.6678 | 7.9954 | 0.0094 | 0.0094 |

**Table 4. Comparison of distributions for seedling emergence toxicity data for propazine.**

| distribution | AICc | ∆AICc | Weight | HC05 |
| --- | --- | --- | --- | --- |
| triangular | 6.3385 | 0 | 0.3616 | 0.0194 |
| normal | 7.4552 | 1.1168 | 0.2069 | 0.0166 |
| gumbel | 7.9764 | 1.6380 | 0.1594 | 0.0211 |
| logistic | 8.1870 | 1.8486 | 0.1435 | 0.0138 |
| weibull | 8.8084 | 2.4699 | 0.1052 | 0.0062 |

1. Goodness of fit

The plot of the cumulative distribution functions for the best-fit distributions (as determined by AICc) suggest little evidence of lack-of-fit (**Figures 1** and **2**). Bootstrap goodness-of-fit tests showed evidence for lack-of-fit (P-values < 0.05, **Tables 5** and **6**) for the Weibul and triangular distributions. The coefficient of variation for the HC05 was exceeded 1 for several distributions.



**Figure 1. Log-gumbel SSD for propazine toxicity values for terrestrial plants at the vegetative vigor life stage.** Black points indicate single toxicity values.



**Figure 2. Log-triangular SSD for propazine toxicity values for terrestrial plants at the seedling emergence.** Black points indicate single toxicity values.

**Table 6. Range of HC05 values for propazine SSDs for terrestrial plants at the vegetative vigor life stage.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Distribution** | **Method** | **HC05** | **SE** | **CV** | **Lower CI** | **Upper CI** | **P** |
| Normal | ML | 0.0381 | 0.0227 | 0.5946 | 0.0161 | 0.1054 | 0.1169 |
| Normal | MO | 0.0352 | 0.0212 | 0.6014 | 0.0137 | 0.0953 | 0.0829 |
| Normal | GR | 0.0302 | 0.0168 | 0.5572 | 0.0067 | 0.0688 | 0.0410 |
| Logistic | ML | 0.0378 | 0.0195 | 0.5170 | 0.0156 | 0.0907 | 0.3377 |
| Logistic | MO | 0.0360 | 0.0242 | 0.6736 | 0.0106 | 0.0991 | 0.1319 |
| Logistic | GR | 0.0267 | 0.0160 | 0.5988 | 0.0044 | 0.0662 | 0.0789 |
| Triangular | ML | 0.0358 | 0.0254 | 0.7088 | 0.0200 | 0.1186 | 0.0729 |
| Triangular | MO | 0.0341 | 0.0196 | 0.5761 | 0.0153 | 0.0947 | 0.0450 |
| Triangular | GR | 0.0324 | 0.0166 | 0.5126 | 0.0110 | 0.0735 | 0.0380 |
| Gumbel | ML | 0.0575 | 0.0178 | 0.3105 | 0.0381 | 0.1074 | 0.6513 |
| Gumbel | MO | 0.0504 | 0.0201 | 0.3984 | 0.0245 | 0.0996 | 0.6074 |
| Gumbel | GR | 0.0411 | 0.0179 | 0.4343 | 0.0128 | 0.0763 | 0.2348 |
| Weibull | ML | 0.0094 | 0.0201 | 2.1456 | 0.0010 | 0.0739 | 0.0110 |
| Weibull | GR | 0.0215 | 0.0199 | 0.9229 | 0.0015 | 0.0752 | 0.0140 |
| Burr | ML | 0.058 | 0.0223 | 0.3880 | 0 | 0.1093 | 0.5674 |

ML=maximum likelihood

LCp and UCp=projections of the confidence limits of the HC05 (LCx and UCx) onto the cumulative distribution function of the fitted distribution.

**Table 7. Range of HC05 values for propazine SSDs for terrestrial plants at the seedling emergence life stage.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Distribution** | **Method** | **HC05** | **SE** | **CV** | **Lower CI** | **Upper CI** | **P** |
| Normal | ML | 0.0166 | 0.0198 | 1.1891 | 0.0052 | 0.0772 | 0.8961 |
| Normal | MO | 0.0148 | 0.0172 | 1.1619 | 0.0035 | 0.0636 | 0.9341 |
| Normal | GR | 0.0148 | 0.0172 | 1.1619 | 0.0035 | 0.0636 | 0.9840 |
| Logistic | ML | 0.0138 | 0.0166 | 1.1983 | 0.0030 | 0.0620 | 0.8252 |
| Logistic | MO | 0.8482 | 0.0172 | 1.1619 | 0.0035 | 0.0636 | 0.8482 |
| Logistic | GR | 0.0079 | 0.0103 | 1.3057 | 0.0004 | 0.0369 | 0.9730 |
| Triangular | ML | 0.0194 | 0.0201 | 1.0370 | 0.0099 | 0.0865 | 0.9500 |
| Triangular | MO | 0.0141 | 0.0158 | 1.1217 | 0.0042 | 0.0548 | 0.9810 |
| Triangular | GR | 0.0104 | 0.0126 | 1.2116 | 0.0017 | 0.0473 | 0.9830 |
| Gumbel | ML | 0.0211 | 0.0142 | 0.6749 | 0.0098 | 0.0593 | 0.9351 |
| Gumbel | MO | 0.0248 | 0.0155 | 0.6256 | 0.0101 | 0.0695 | 0.7183 |
| Gumbel | GR | 0.0169 | 0.0112 | 0.6588 | 0.0031 | 0.0449 | 0.9600 |
| Weibull | ML | 0.0062 | 0.0174 | 2.7975 | 0.0006 | 0.0613 | 0.6683 |
| Weibull | GR | 0.0048 | 0.0099 | 2.0632 | 0.00006 | 0.0345 | 0.6134 |
| Burr | ML | 0.0198 | 0.0182 | 0.9196 | 0 | 0.0682 | 0.9071 |

ML=maximum likelihood, MO= moment estimators, and GR=graphical methods

LCp and UCp=projections of the confidence limits of the HC05 (LCx and UCx) onto the cumulative distribution function of the fitted distribution.

1. Test for the need to model results separately by vegetative vigor and seedling emergence life stage

Examination of the cumulative distribution functions plotted on similar axes for vegetative vigor and seedling emergence studies does not support combining the datasets into one distribution. Although the 95% bootstrap confidence intervals for the separate distributions overlap substantially (**Figure 5**), the slopes of the response curves are appreciably different. Additionally, the distributions do not fit well at the endpoint of interest, the HC05. Therefore, the vegetative vigor and seedling emergence distributions will be used separately.

**Figure 5. SSDs for vegetative vibor IC25s (Gumbel) and seedling emergence IC25s (triangular) for propazine**. Blue lines show the distribution and upper and lower confidence interval for species from vegetative vigor studies. Red lines show the distribution and upper and lower confidence interval for species from seedling emergence studies.

1. Calculation of other quantiles

**Tables 8 - 11** provides estimates of the HC05 as well as other quantiles of the fitted SSDs.

**Table 8. Estimated quantiles of the fitted SSDs for propazine IC25s for terrestrial plants at the vegetative vigor life stage.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Distribution** | **Method** | **HC05** | **HC10** | **HC50** | **HC90** | **HC95** |
| Weibull | ML | 0.0094 | 0.0225 | 0.2247 | 0.9732 | 1.3419 |
| Weibull | GR | 0.0215 | 0.0413 | 0.2268 | 0.6715 | 0.8520 |
| Normal | ML | 0.0381 | 0.0551 | 0.2011 | 0.7320 | 1.0599 |
| Normal | MO | 0.0352 | 0.0517 | 0.2011 | 0.7821 | 1.1495 |
| Normal | GR | 0.0302 | 0.0459 | 0.2011 | 0.8813 | 1.3398 |
| Logistic | ML | 0.0378 | 0.0557 | 0.1778 | 0.5448 | 0.8030 |
| Logistic | MO | 0.0360 | 0.0557 | 0.2011 | 0.7261 | 1.1236 |
| Logistic | GR | 0.0267 | 0.0446 | 0.2011 | 0.9067 | 1.5132 |
| Triangular | ML | 0.0358 | 0.0511 | 0.2290 | 1.0271 | 1.4657 |
| Triangular | MO | 0.0341 | 0.0479 | 0.2011 | 0.8446 | 1.1867 |
| Triangular | GR | 0.0324 | 0.0459 | 0.2011 | 0.8805 | 1.2493 |
| Gumbel | ML | 0.0575 | 0.698 | 0.1699 | 0.6851 | 1.1672 |
| Gumbel | MO | 0.0504 | 0.0626 | 0.1689 | 0.8014 | 1.4528 |
| Gumbel | GR | 0.0411 | 0.0534 | 0.1762 | 1.1464 | 2.3451 |
| Burr | ML | 0.0575 | 0.070 | 0.170 | 0.685 | 1.166 |

**Table 9. Estimated quantiles of the fitted SSDs for propazine IC25s for terrestrial plants at the seedling emergence life stage.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Distribution** | **Method** | **HC05** | **HC10** | **HC50** | **HC90** | **HC95** |
| Normal | ML | 0.0166 | 0.0282 | 0.1818 | 1.1727 | 1.9892 |
| Normal | MO | 0.0148 | 0.0257 | 0.1818 | 1.2844 | 2.2356 |
| Normal | GR | 0.0077 | 0.0180 | 0.1818 | 1.8363 | 3.5371 |
| Logistic | ML | 0.0138 | 0.0264 | 0.1762 | 1.1761 | 2.2429 |
| Logistic | MO | 0.0153 | 0.0286 | 0.1818 | 1.1540 | 2.1635 |
| Logistic | GR | 0.0079 | 0.0175 | 0.1818 | 1.8866 | 4.1804 |
| Triangular | ML | 0.0194 | 0.0297 | 0.1812 | 1.1040 | 1.6941 |
| Triangular | MO | 0.0141 | 0.0230 | 0.1818 | 1.4346 | 2.3404 |
| Triangular | GR | 0.0104 | 0.0179 | 0.1818 | 1.8418 | 3.1881 |
| Gumbel | ML | 0.0211 | 0.0298 | 0.1437 | 1.6997 | 4.6547 |
| Gumbel | MO | 0.0248 | 0.0339 | 0.1415 | 1.3303 | 3.1316 |
| Gumbel | GR | 0.0169 | 0.0250 | 0.1492 | 2.4549 | 7.1581 |
| Weibull | ML | 0.0062 | 0.0168 | 0.2282 | 1.2008 | 1.7281 |
| Weibull | GR | 0.0048 | 0.0139 | 0.2211 | 1.2923 | 1.9030 |
| Burr | ML | 0.0198 | 0.0303 | 0.1556 | 1.4342 | 3.2567 |

**Table 10** provides all of the available IC25 values for vegetative vigor and seedling emergence studies. These data sets are the same as reported in the effects characterization and provide additional data for the formulated products. Values that were included in the SSD (*i.e.,* TGAI) are marked with an \*.

**Table 11. Available effective inhibition concentration (IC25) data for terrestrial plants exposed to propazine.**

|  |  |  |
| --- | --- | --- |
|  | **Vegetative vigor** | **Seedling Emergence** |
| **Species** | **Toxicity value** | **Replicates** | **ECDF\*** | **Toxicity value** | **Replicates** | **ECDF\*** |
| Zea mays | 2.5 | 1 | 0.9167 | 2.4 | 1 | 0.9167 |
| Glycine max | 0.66 | 1 | 0.8333 | 0.979 | 1 | 0.8333 |
| Allium cepa | 0.229 | 1 | 0.75 | 0.818 | 1 | 0.7500 |
| Raphanus sativus | 0.219 | 1 | 0.6667 | 0.370 | 1 | 0.6667 |
| Lolium perenne | 0.211 | 1 | 0.5833 | 0.199 | 1 | 0.5833 |
| Solanum lycopersicum | 0.151 | 1 | 0.5000 | 0.172 | 1 | 0.5000 |
| Brassica oleracea | 0.127 | 1 | 0.4167 | 0.108 | 1 | 0.4167 |
| Avena sativa | 0.122 | 1 | 0.3333 | 0.101 | 1 | 0.3333 |
| Lactuca sativa | 0.114 | 1 | 0.25 | 0.049 | 1 | 0.2500 |
| Cucumis sativus | 0.097 | 1 | 0.1667 | 0.035 | 1 | 0.1667 |
| Triticum aestivum | 0.0481 | 1 | 0.0833 | 0.016 | 1 | 0.0833 |

\*Empirical Cumulative Distribution Function