Supplementary Information File:
Soybean Response to Dicamba: A Meta-Analysis

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Height Data

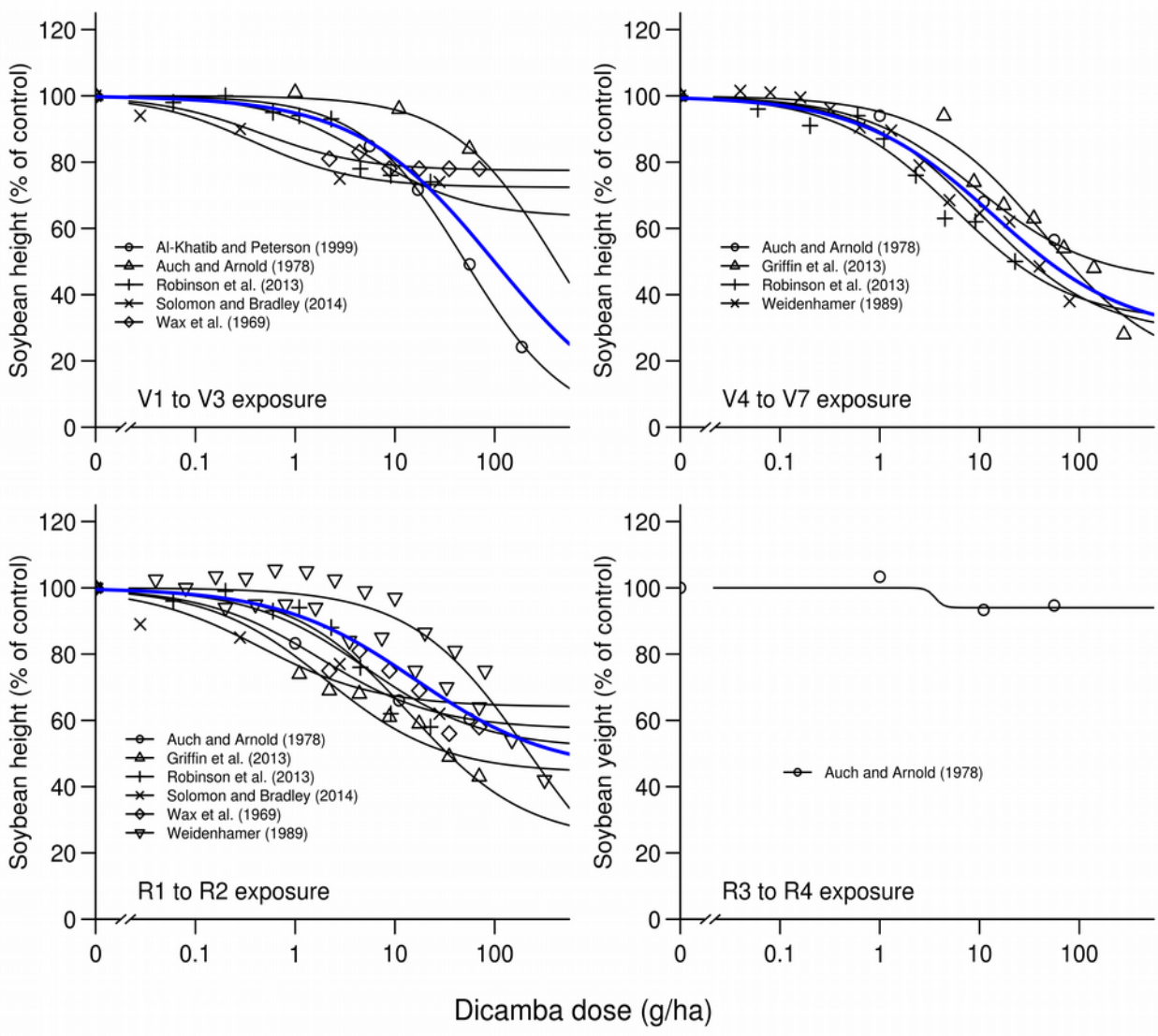

Figure S1. Effect of dicamba dose on soybean height. Gray symbols & lines in each panel represent a separate study, blue lines represent the pooled data model.

Height Data, V1 to V3 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) (3 parms)
##
## Parameter estimates:
##
##                                  Estimate Std. Error t-value   p-value
## b:(Intercept)                     0.83974    0.16816  4.9938 4.223e-05
## c:Al-Khatib and Peterson (1999)   0.00000   18.24983  0.0000   1.00000
## c:Auch and Arnold (1978)          0.00000  392.09610  0.0000   1.00000
## c:Robinson et al. (2013)         63.34301   11.12064  5.6960 7.228e-06
## c:Solomon and Bradley (2014)     72.35997    4.73519 15.2813 7.239e-14
## c:Wax et al. (1969)              77.47228    3.39825 22.7977 < 2.2e-16
## e:Al-Khatib and Peterson (1999)  50.75689   26.66719  1.9033   0.06906
## e:Auch and Arnold (1978)        411.96459 2273.82686  0.1812   0.85775
## e:Robinson et al. (2013)          5.53734    4.67069  1.1855   0.24741
## e:Solomon and Bradley (2014)      0.38127    0.35622  1.0703   0.29512
## e:Wax et al. (1969)               0.44934    0.84765  0.5301   0.60091
##
## b:(Intercept)                    ***
## c:Al-Khatib and Peterson (1999)
## c:Auch and Arnold (1978)
## c:Robinson et al. (2013)         ***
## c:Solomon and Bradley (2014)     ***
## c:Wax et al. (1969)              ***
## e:Al-Khatib and Peterson (1999) .
## e:Auch and Arnold (1978)
## e:Robinson et al. (2013)
## e:Solomon and Bradley (2014)
## e:Wax et al. (1969)
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  4.908876 (24 degrees of freedom)
```

Height Data, V1 to V3 model output (pooled data):

```
##
## Model fitted: Log-logistic (ED50 as parameter) (3 parms)
##
## Parameter estimates:
##
##               Estimate Std. Error t-value   p-value
## b:(Intercept)  0.63146    0.12575  5.0215 1.867e-05 ***
## c:(Intercept)  0.00000   29.25848  0.0000    1.0000
## e:(Intercept) 99.19861   86.73914  1.1436    0.2613
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  10.35178 (32 degrees of freedom)
```

Height Data, V4 to V7 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) (3 parms)
##
## Parameter estimates:
##
##                           Estimate Std. Error t-value   p-value
## b:(Intercept)              0.73832    0.11955  6.1758 2.218e-07 ***
## c:Auch and Arnold (1978) 43.75339   10.69450  4.0912 0.0001902 ***
## c:Griffin et al. (2013)  16.77321   15.09717  1.1110 0.2728813
## c:Robinson et al. (2013) 31.93680   16.23538  1.9671 0.0557993 .
## c:Weidenhamer (1989)     28.03210   11.48080  2.4417 0.0189132 *
## e:Auch and Arnold (1978)  9.38525    6.68163  1.4046 0.1674824
## e:Griffin et al. (2013)  43.84897   26.84966  1.6331 0.1099173
## e:Robinson et al. (2013)  5.51289    4.03961  1.3647 0.1796118
## e:Weidenhamer (1989)     10.48918    5.82049  1.8021 0.0787078 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  5.661218 (42 degrees of freedom)
```

Height Data, V4 to V7 model output (pooled data):

```
##
## Model fitted: Log-logistic (ED50 as parameter) (3 parms)
##
## Parameter estimates:
##
##               Estimate Std. Error t-value   p-value
## b:(Intercept)  0.64506    0.11742  5.4934 1.474e-06 ***
## c:(Intercept) 27.90236   11.81487  2.3616    0.0223 *
## e:(Intercept) 13.76468    8.59436  1.6016    0.1158
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  7.000232 (48 degrees of freedom)
```

Height Data, R1 to R2 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) (3 parms)
##
## Parameter estimates:
##
##                                Estimate Std. Error t-value   p-value
## b:(Intercept)                   0.74070    0.14278  5.1878 1.930e-06 ***
## c:Auch and Arnold (1978)       57.32465    5.10100 11.2379 < 2.2e-16 ***
## c:Griffin et al. (2013)        44.17632    8.16253  5.4121 8.009e-07 ***
## c:Robinson et al. (2013)       23.58270   38.82316  0.6074    0.5455
## c:Solomon and Bradley (2014)   64.06496    9.97381  6.4233 1.316e-08 ***
## c:Wax et al. (1969)            51.59566   11.34403  4.5483 2.175e-05 ***
## c:Weidenhamer (1989)            0.00000   44.72442  0.0000    1.0000
## e:Auch and Arnold (1978)        1.78712    1.13459  1.5751    0.1197
## e:Griffin et al. (2013)         2.05354    1.50571  1.3638    0.1769
## e:Robinson et al. (2013)       14.25019   18.51373  0.7697    0.4440
## e:Solomon and Bradley (2014)    0.45356    0.82059  0.5527    0.5822
## e:Wax et al. (1969)             5.14567    5.16012  0.9972    0.3221
## e:Weidenhamer (1989)          222.46244  248.99059  0.8935    0.3746
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  7.55827 (71 degrees of freedom)
```

Height Data, R1 to R2 model output (pooled data):

```
##
## Model fitted: Log-logistic (ED50 as parameter) (3 parms)
##
## Parameter estimates:
##
##               Estimate Std. Error t-value  p-value
## b:(Intercept)  0.63589    0.21898  2.9039 0.004748 **
## c:(Intercept) 44.58508   19.18504  2.3240 0.022635 *
## e:(Intercept) 16.04353   20.68763  0.7755 0.440295
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  11.47447 (81 degrees of freedom)
```

Height Data, R3 to R4 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) (3 parms)
##
## Parameter estimates:
##
##               Estimate Std. Error t-value   p-value
## b:(Intercept)  10.0000   334.3513  0.0299    0.9768
## c:(Intercept)  94.0000     2.9877 31.4621 1.624e-10 ***
## e:(Intercept)   3.5904   144.2606  0.0249    0.9807
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  7.318171 (9 degrees of freedom)
```

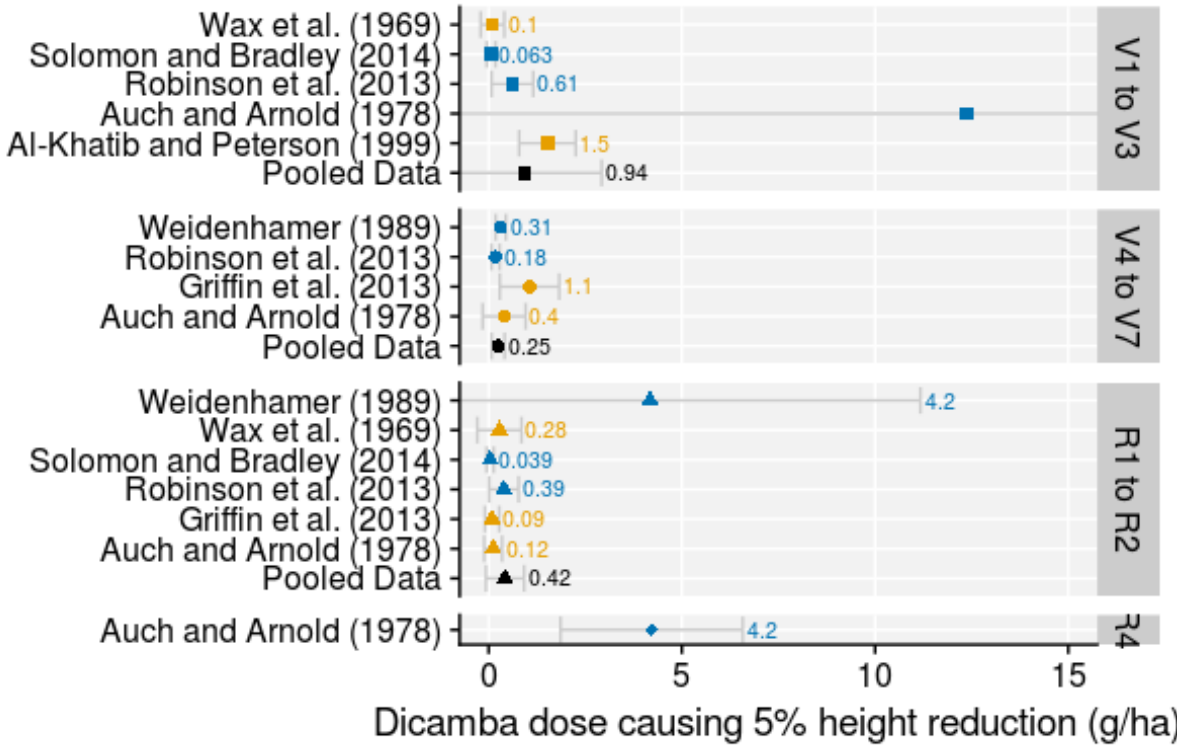

Figure S2. Estimated dose of dicamba causing 5% soybean height reduction as influenced by growth stage at exposure. Bars represent 95% confidence intervals around the estimates.

Soybean Visible Injury Response to Dicamba Dose

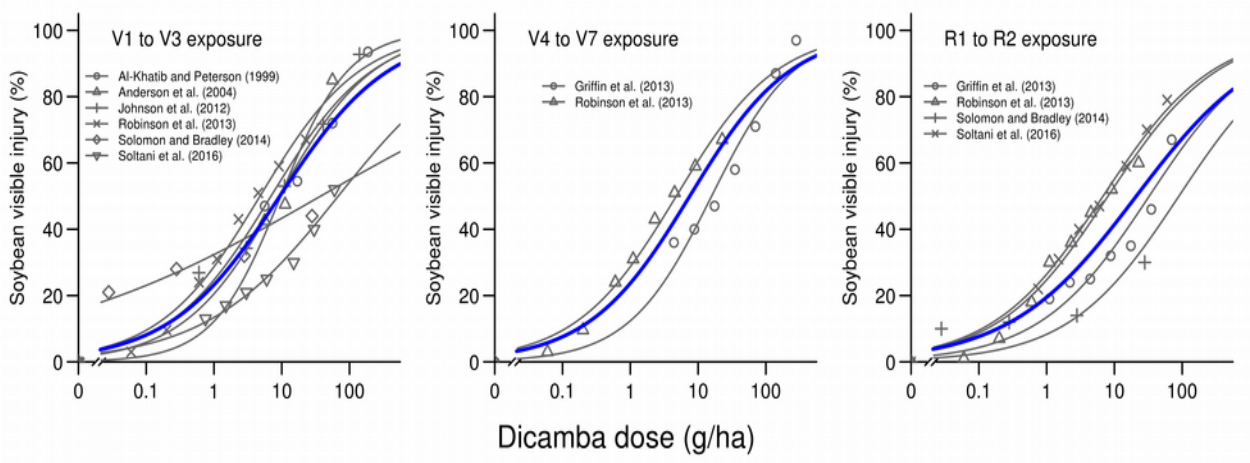

Figure S3. Effect of dicamba dose on soybean visible injury 14 days after exposure. Gray symbols & lines in each panel represent a separate study, blue lines represent the pooled data model.

Injury Response to Dicamba Dose, V1 to V3 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##                                  Estimate Std. Error t-value   p-value
## b:Al-Khatib and Peterson (1999) -0.615027   0.151735 -4.0533 0.0001694 ***
## b:Anderson et al. (2004)        -0.868372   0.242127 -3.5864 0.0007402 ***
## b:Johnson et al. (2012)         -0.574829   0.074921 -7.6725 4.205e-10 ***
## b:Robinson et al. (2013)        -0.582095   0.131955 -4.4113 5.193e-05 ***
## b:Solomon and Bradley (2014)    -0.203275   0.077185 -2.6336 0.0111010 *
## b:Soltani et al. (2016)         -0.441663   0.159205 -2.7742 0.0076686 **
## e:Al-Khatib and Peterson (1999)  9.043548   3.099222  2.9180 0.0051930 **
## e:Anderson et al. (2004)         9.681797   2.198599  4.4036 5.329e-05 ***
## e:Johnson et al. (2012)          6.944081   1.431676  4.8503 1.160e-05 ***
## e:Robinson et al. (2013)         4.778046   1.598612  2.9889 0.0042681 **
## e:Solomon and Bradley (2014)    37.544575  42.755438  0.8781 0.3839159
## e:Soltani et al. (2016)         68.248285  49.835121  1.3695 0.1767343
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  10.19482 (52 degrees of freedom)
```

Injury Response to Dicamba Dose, V1 to V3 mixed model (pooled data):

```
## Nonlinear mixed-effects model fit by maximum likelihood
##   Model: Injury ~ 5.26/(0.0526 + exp(b * (log(Dose.gha) - log(edi95))))
##  Data: dicdat.yldv3
##        AIC      BIC    logLik
##   514.9159 527.8692 -251.4579
##
## Random effects:
##  Formula: list(edi95 ~ 1, b ~ 1)
##  Level: Study
##  Structure: General positive-definite, Log-Cholesky parametrization
##          StdDev       Corr
## edi95    1.427448e-06 edi95
## b        9.308642e-07 0
## Residual 1.230606e+01
##
## Fixed effects: b + edi95 ~ 1
##            Value  Std.Error DF   t-value p-value
## b     -0.5343571 0.05741375 57 -9.307128  0.0000
## edi95  0.0378247 0.02329046 57  1.624044  0.1099
##  Correlation:
##       b
## edi95 -0.967
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -2.1343368 -0.4397765  0.0000000  0.7881607  2.3790518
##
## Number of Observations: 64
## Number of Groups: 6
```

Injury Response to Dicamba Dose, V4 to V7 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##                            Estimate Std. Error t-value   p-value
## b:Griffin et al. (2013)  -0.707999   0.074089 -9.5560 3.039e-07 ***
## b:Robinson et al. (2013) -0.582339   0.060278 -9.6609 2.681e-07 ***
## e:Griffin et al. (2013)  15.847574   2.092474  7.5736 4.052e-06 ***
## e:Robinson et al. (2013)  4.770309   0.728003  6.5526 1.846e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  4.65822 (13 degrees of freedom)
```

Injury Response to Dicamba Dose, V4 to V7 mixed model (pooled data):

```
## Nonlinear mixed-effects model fit by maximum likelihood
##   Model: Injury ~ 5.26/(0.0526 + exp(b * (log(Dose.gha) - log(edi95))))
##  Data: dicdat.yldv7
##        AIC      BIC   logLik
##   122.5586 127.5579 -55.2793
##
## Random effects:
##  Formula: list(edi95 ~ 1, b ~ 1)
##  Level: Study
##  Structure: General positive-definite, Log-Cholesky parametrization
##          StdDev       Corr
## edi95    1.449504e-07 edi95
## b        5.090211e-02 -1
## Residual 5.513787e+00
##
## Fixed effects: b + edi95 ~ 1
##            Value  Std.Error DF   t-value p-value
## b     -0.5786664 0.06684828 14 -8.656413  0.0000
## edi95  0.0464439 0.02288256 14  2.029664  0.0618
##  Correlation:
##       b
## edi95 -0.79
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -1.4704944 -0.5107056  0.0000000  0.5969887  2.3112124
##
## Number of Observations: 17
## Number of Groups: 2
```

Injury Response to Dicamba Dose, R1 to R2 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##                                 Estimate  Std. Error t-value p-value
## b:Griffin et al. (2013)      -0.50076936  0.23058786 -2.1717 0.04094 *
## b:Robinson et al. (2013)     -0.55537130  0.19721510 -2.8161 0.01006 *
## b:Solomon and Bradley (2014) -0.00069672  0.00042863 -1.6255 0.11830
## b:Soltani et al. (2016)      -0.56048352  0.19908487 -2.8153 0.01008 *
## e:Griffin et al. (2013)      34.96882295 23.21240283  1.5065 0.14617
## e:Robinson et al. (2013)      7.74709583  4.42762327  1.7497 0.09410 .
## e:Solomon and Bradley (2014)  0.24377337  2.41420203  0.1010 0.92049
## e:Soltani et al. (2016)       6.80648092  3.22100671  2.1132 0.04616 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
## Residual standard error:
##
##  15.10993 (22 degrees of freedom)
```

Injury Response to Dicamba Dose, R1 to R2 mixed model (pooled data):

```
## Nonlinear mixed-effects model fit by maximum likelihood
##   Model: Injury ~ 5.26/(0.0526 + exp(b * (log(Dose.gha) - log(edi95))))
##  Data: dicdat.yldr
##        AIC      BIC    logLik
##   191.1339 199.5411 -89.56697
##
## Random effects:
##  Formula: list(edi95 ~ 1, b ~ 1)
##  Level: Study
##  Structure: General positive-definite, Log-Cholesky parametrization
##          StdDev      Corr
## edi95    0.001479771 edi95
## b        0.104646679 -1
## Residual 3.690926400
##
## Fixed effects: b + edi95 ~ 1
##            Value  Std.Error DF   t-value p-value
## b     -0.4657947 0.06024023 25 -7.732285  0.0000
## edi95  0.0377298 0.01127921 25  3.345070  0.0026
##  Correlation:
##       b
## edi95 -0.476
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -1.8071162 -0.6951246  0.0000000  0.4271587  2.9133980
##
## Number of Observations: 30
## Number of Groups: 4
```

Tests for Hormesis

Auch and Arnold (1978) model output

```
coef(summary(aa78.drmH))
##               Estimate  Std. Error   t-value    p-value
## b:V1 to V3   0.3205041   0.2907164 1.1024628 0.27964670
## b:V4 to V7   0.5949717   0.5328651 1.1165522 0.27367615
## b:R1 to R2   0.4866675   0.2380397 2.0444803 0.05041148
## b:R3 to R4   0.8876050   0.6920701 1.2825363 0.21017097
## e:V1 to V3 176.2647826 568.8239395 0.3098758 0.75894998
## e:V4 to V7  70.2881684 153.8688876 0.4568056 0.65133498
## e:R1 to R2  18.8224904  84.9810332 0.2214905 0.82631795
## e:R3 to R4  26.0722993  38.6569517 0.6744531 0.50555426
## f:V1 to V3  59.8024964  84.8402725 0.7048834 0.48670534
## f:V4 to V7  46.9802635  89.9262280 0.5224312 0.60547944
## f:R1 to R2  21.7313445 144.9255663 0.1499483 0.88188032
## f:R3 to R4  26.4514744  75.3079173 0.3512443 0.72803442
AIC(aa78.drm, aa78.drmH)
##           df      AIC
## aa78.drm   9 337.5085
## aa78.drmH 13 343.7247
anova(aa78.drm, aa78.drmH)
##
## 1st model
##  fct:      LL.3(fixed = c(NA, 100, NA))
## 2nd model
##  fct:      cedergreen(fixed = c(NA, 0, 100, NA, NA), alpha = 0.9)
## ANOVA table
##
##           ModelDf    RSS Df F value p value
## 1st model      32 6896.1
## 2nd model      28 6595.4  4  0.3192  0.8627
## png
##   2
```

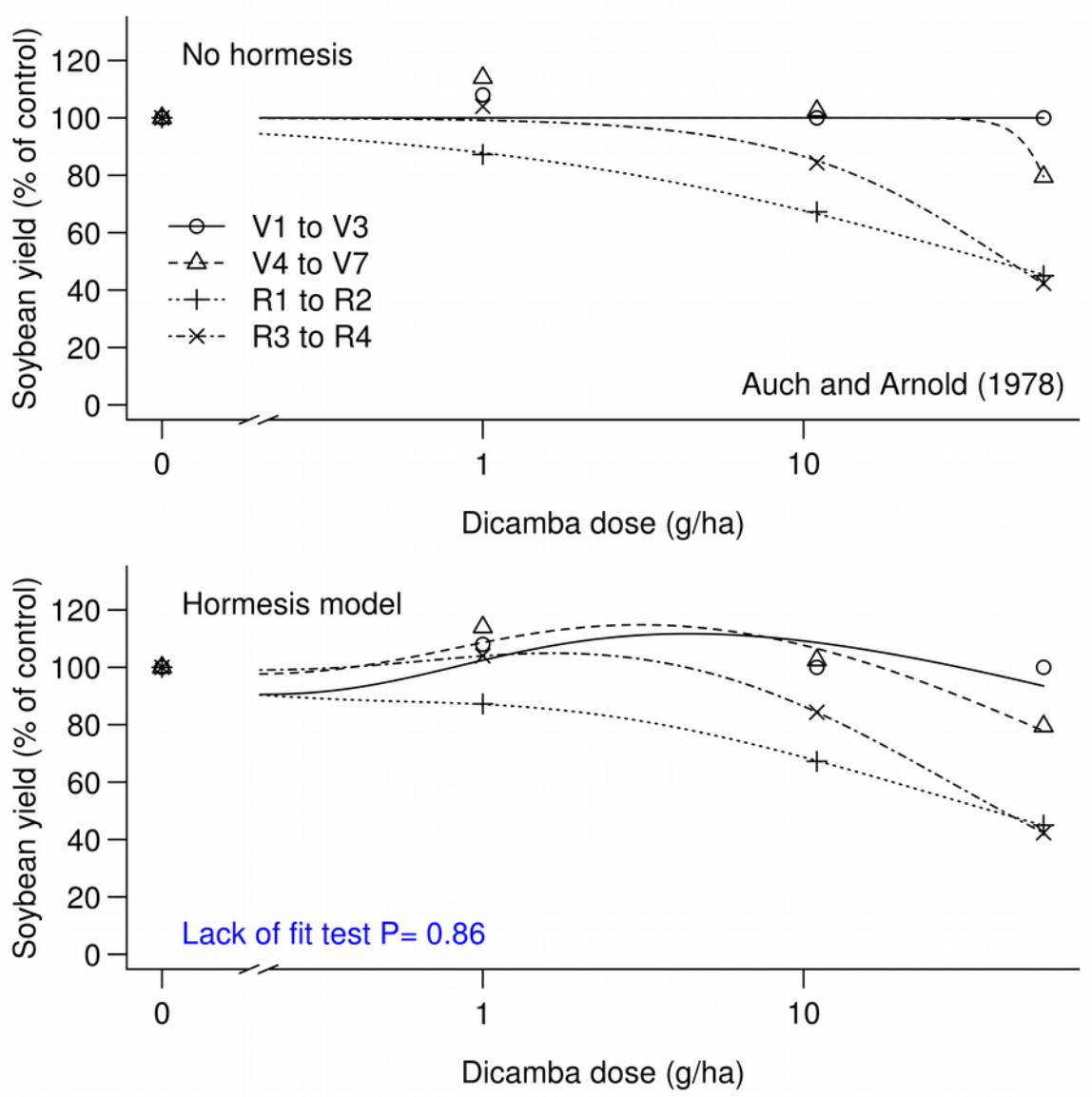

Figure S4. Hormesis analysis for data from Auch and Arnold (1978).

Robinson (2013) model output

```
coef(summary(r13.drmH))
##                Estimate   Std. Error     t-value      p-value
## b:V1 to V3    0.2941902 5.458754e-02  5.38932873 4.029126e-05
## b:V4 to V7    0.7635650 1.833854e-01  4.16371854 5.834080e-04
## b:R1 to R2    1.1026580 4.239786e-01  2.60073975 1.807124e-02
## e:V1 to V3 2190.3147621 2.755962e+03  0.79475498 4.371103e-01
## e:V4 to V7   28.1913296 1.581158e+01  1.78295482 9.146657e-02
## e:R1 to R2   32.5918873 7.495031e+00  4.34846606 3.871999e-04
## f:V1 to V3    4.4907895 8.131995e+00  0.55223714 5.875781e-01
## f:V4 to V7   -0.3940337 2.073659e+01 -0.01900186 9.850487e-01
## f:R1 to R2  -11.4574615 1.236405e+01 -0.92667522 3.663543e-01
AIC(r13.drm, r13.drmH)
##          df      AIC
## r13.drm   5 164.4163
## r13.drmH 10 154.1452
anova(r13.drm, r13.drmH)
##
## 1st model
##  fct:     LL.3(fixed = c(NA, 100, NA))
##  pmodels: 1, Stage
## 2nd model
##  fct:     cedergreen(fixed = c(NA, 0, 100, NA, NA), alpha = 0.7)
##  pmodels: Stage (for all parameters)
## ANOVA table
##
##           ModelDf    RSS Df F value p value
## 1st model      23 481.58
## 2nd model      18 227.31  5  4.0272  0.0125
## png
##   2
```

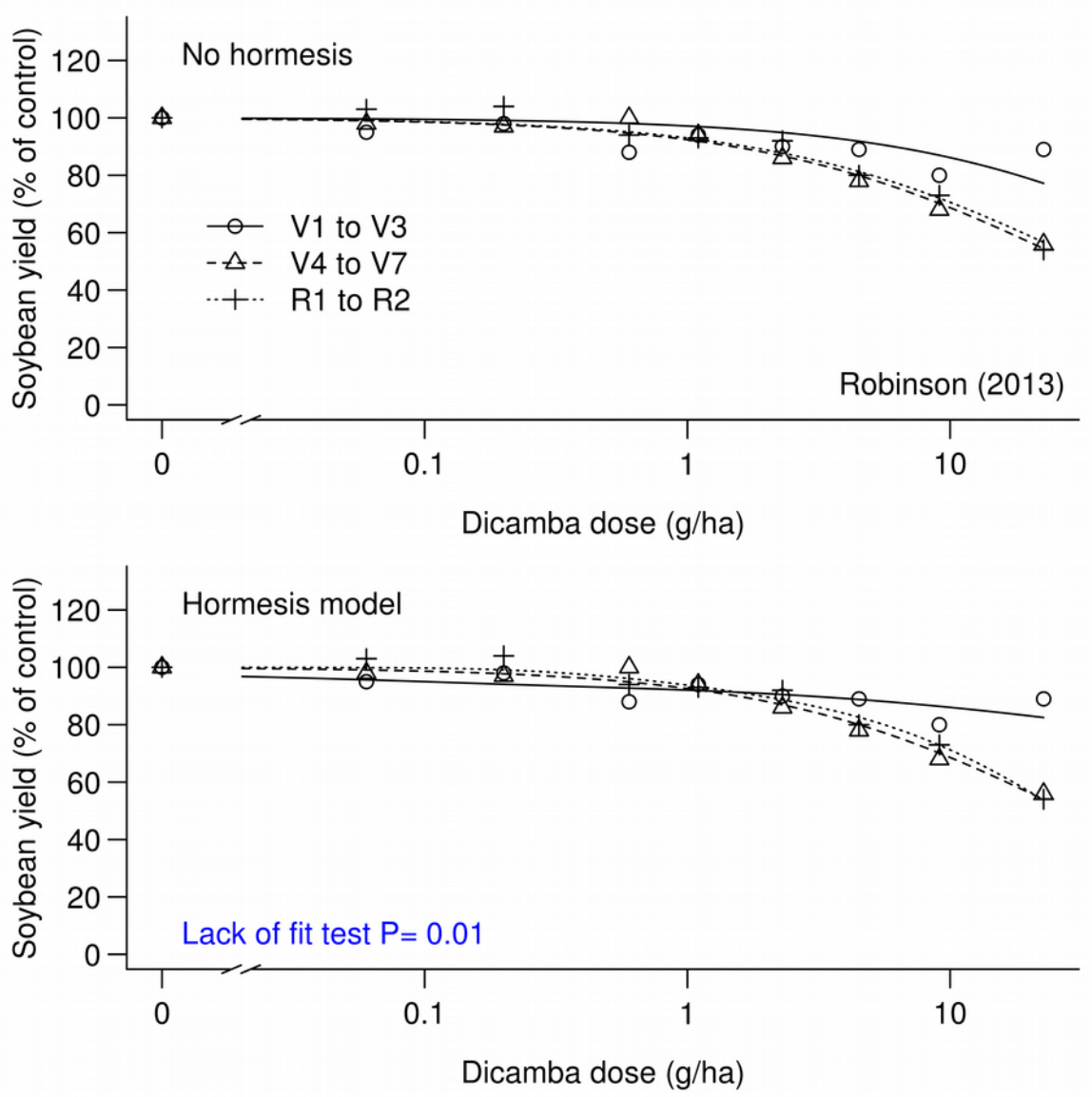

Figure S5. Hormesis analysis for data from Robinson (2013).

Weidenhamer (1989) model output

```
coef(summary(w89.drmH))
##                Estimate Std. Error      t-value      p-value
## b:V4 to V7   1.1678534   0.770714  1.515287615 1.350391e-01
## b:R1 to R2   2.3904262   0.838650  2.850326387 6.007574e-03
## e:V4 to V7 121.2162656  48.806945  2.483586410 1.586726e-02
## e:R1 to R2  84.0058320  10.709745  7.843868502 1.005360e-10
## f:V4 to V7   0.0494978  11.314429  0.004374751 9.965242e-01
## f:R1 to R2  -8.0330716   5.490838 -1.462995434 1.487758e-01
AIC(w89.drm, w89.drmH)
##          df      AIC
## w89.drm   5 511.0426
## w89.drmH  7 513.0734
anova(w89.drm, w89.drmH)
##
## 1st model
##  fct:      LL.3(fixed = c(NA, 100, NA))
## 2nd model
##  fct:      cedergreen(fixed = c(NA, 0, 100, NA, NA), alpha = 0.7)
## ANOVA table
##
##           ModelDf    RSS Df F value p value
## 1st model      61 8474.8
## 2nd model      59 8222.0  2  0.9074  0.4091
## png
##   2
```

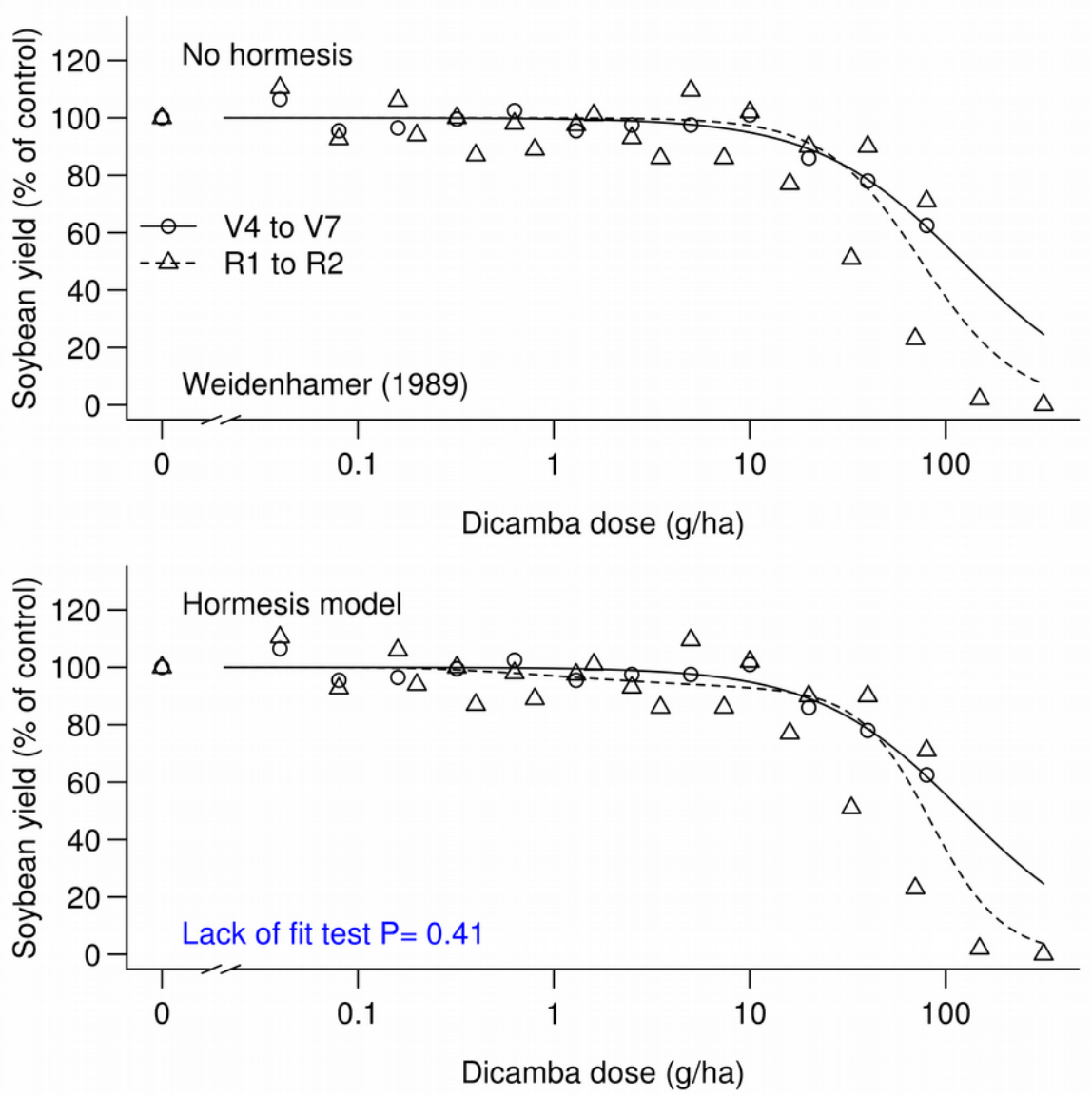

Figure S6. Hormesis analysis for data from Weidenhamer (1989).

Soybean Yield Response to Dicamba Dose

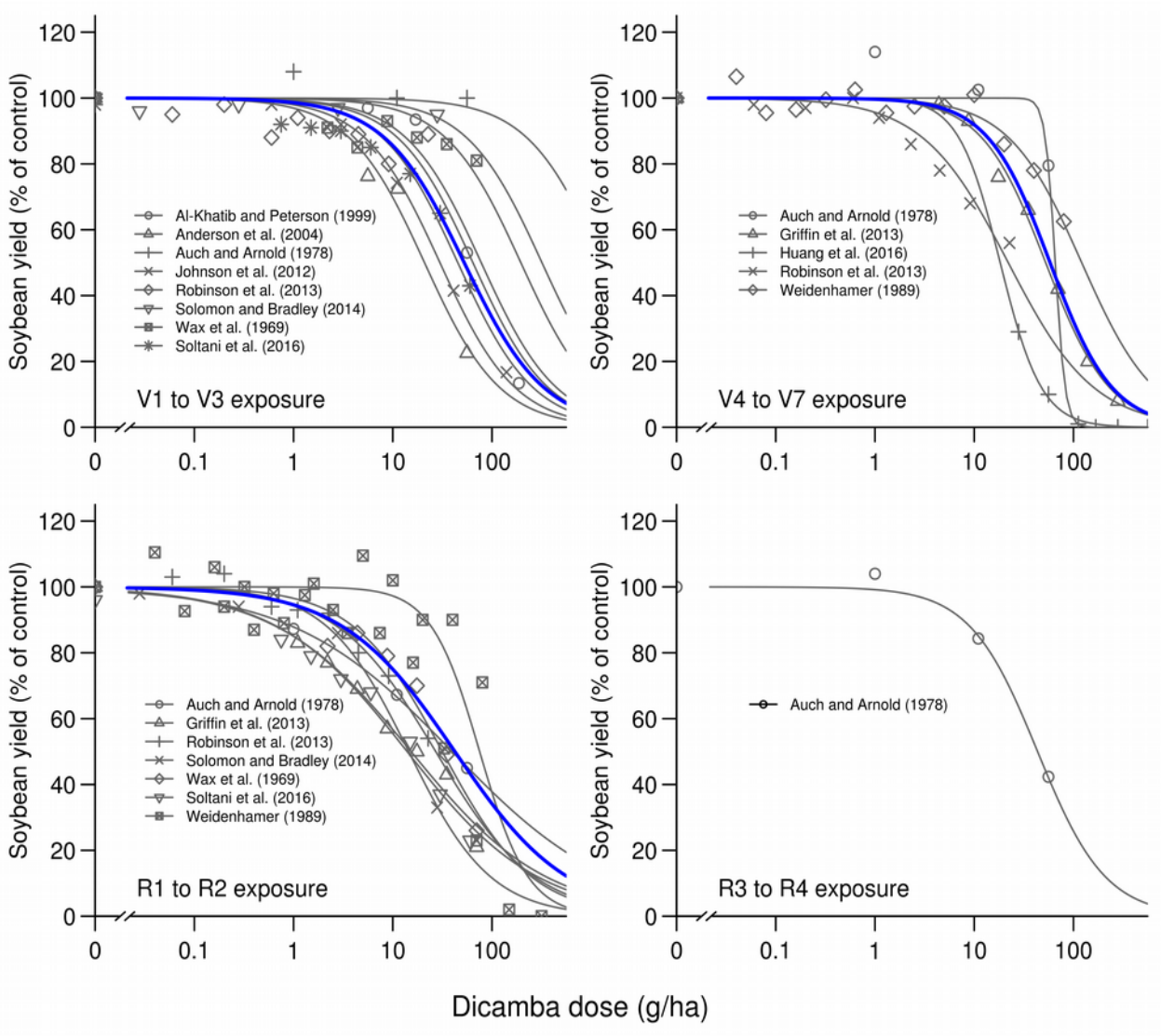

Figure S7. Effect of dicamba dose on soybean yield. Gray symbols & lines in each panel represent a separate study, blue lines represent the pooled data model.

Yield Response to Dicamba Dose, V1 to V3 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##                                  Estimate Std. Error t-value   p-value
## b:Al-Khatib and Peterson (1999)   1.80041    0.52611  3.4222 0.0011345 **
## b:Anderson et al. (2004)          1.14164    0.29686  3.8457 0.0002973 ***
## b:Auch and Arnold (1978)         13.61312   10.00000  1.3613 0.1785916
## b:Johnson et al. (2012)           1.05132    0.17289  6.0807 9.496e-08 ***
## b:Robinson et al. (2013)          1.00000    0.96508  1.0362 0.3043453
## b:Solomon and Bradley (2014)      3.07102    2.60073  1.1808 0.2424087
## b:Soltani et al. (2016)           1.00000    0.45315  2.2068 0.0312324 *
## b:Wax et al. (1969)               1.00000    0.47717  2.0957 0.0404076 *
## e:Al-Khatib and Peterson (1999)  61.79238    7.21517  8.5642 6.123e-12 ***
## e:Anderson et al. (2004)         20.87278    4.38865  4.7561 1.314e-05 ***
## e:Auch and Arnold (1978)        200.20263   10.00000 20.0203 < 2.2e-16 ***
## e:Johnson et al. (2012)          29.91461    4.41440  6.7766 6.455e-09 ***
## e:Robinson et al. (2013)         88.87535   10.21011  8.7046 3.560e-12 ***
## e:Solomon and Bradley (2014)     73.11839    9.99197  7.3177 7.834e-10 ***
## e:Soltani et al. (2016)          47.18198    8.63878  5.4616 9.913e-07 ***
## e:Wax et al. (1969)             226.58839   10.00682 22.6434 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  11.95834 (59 degrees of freedom)
```

Yield Response to Dicamba Dose, V1 to V3 mixed model (pooled data):

```
## Nonlinear mixed-effects model fit by maximum likelihood
##   Model: Yield ~ 1900/(19 + exp(b * (log(Dose.gha) - log(yl95))))
##  Data: dicdat.yldv3
##        AIC      BIC    logLik
##   611.7394 625.6443 -299.8697
##
## Random effects:
##  Formula: list(yl95 ~ 1, b ~ 1)
##  Level: Study
##  Structure: General positive-definite, Log-Cholesky parametrization
##          StdDev       Corr
## yl95     2.878515e-07 yl95
## b        3.376729e-01 -0.248
## Residual 1.186220e+01
##
```

```
## Fixed effects: b + yl95 ~ 1
##          Value Std.Error DF  t-value p-value
## b    0.7189857 0.1603313 66 4.484375  0.0000
## yl95 1.8928953 0.5926709 66 3.193839  0.0022
##  Correlation:
##      b
## yl95 0.517
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -2.7650387 -0.3797181  0.0000000  0.2454188  3.6624784
##
## Number of Observations: 75
## Number of Groups: 8
```

Yield Response to Dicamba Dose, V4 to V7 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##                            Estimate Std. Error t-value   p-value
## b:(Intercept)               1.19914    0.11169 10.7368 8.433e-15 ***
## e:Auch and Arnold (1978) 186.07395   49.19570  3.7823 0.0004027 ***
## e:Griffin et al. (2013)   52.56651    6.01302  8.7421 8.719e-12 ***
## e:Huang et al. (2016)     11.18810    2.86093  3.9107 0.0002681 ***
## e:Robinson et al. (2013)  20.24084    3.30564  6.1231 1.230e-07 ***
## e:Weidenhamer (1989)     118.84383   16.66484  7.1314 3.054e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  6.227669 (52 degrees of freedom)
```

Yield Response to Dicamba Dose, V4 to V7 mixed model (pooled data):

```
## Nonlinear mixed-effects model fit by maximum likelihood
##   Model: Yield ~ 1900/(19 + exp(b * (log(Dose.gha) - log(yl95))))
##  Data: dicdat.yldv7
##        AIC      BIC    logLik
##   409.6191 421.9818 -198.8096
##
## Random effects:
##  Formula: list(yl95 ~ 1, b ~ 1)
##  Level: Study
##  Structure: General positive-definite, Log-Cholesky parametrization
##          StdDev       Corr
## yl95     4.7076523802 yl95
## b        0.0002037656 0.057
## Residual 6.2080297989
##
```

```
## Fixed effects: b + yl95 ~ 1
##         Value Std.Error DF   t-value p-value
## b    1.144538 0.1071706 52 10.679592  0.0000
## yl95 5.651491 2.3886525 52  2.365975  0.0217
##  Correlation:
##      b
## yl95 0.376
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -1.8816266 -0.4592684  0.0000000  0.5380925  3.3843902
##
## Number of Observations: 58
## Number of Groups: 5
```

Yield Response to Dicamba Dose, R1 to R2 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##                               Estimate Std. Error t-value   p-value
## b:(Intercept)                  0.89390    0.10333  8.6508 2.993e-13 ***
## e:Auch and Arnold (1978)      33.55587    8.30309  4.0414 0.0001172 ***
## e:Griffin et al. (2013)       14.63031    4.50760  3.2457 0.0016835 **
## e:Robinson et al. (2013)      26.44928   10.80212  2.4485 0.0164247 *
## e:Solomon and Bradley (2014) 14.49853    7.30510  1.9847 0.0504405 .
## e:Soltani et al. (2016)       13.50878    4.30383  3.1388 0.0023409 **
## e:Wax et al. (1969)           32.17821    9.81105  3.2798 0.0015132 **
## e:Weidenhamer (1989)          90.59647   17.51915  5.1713 1.552e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  12.88863 (84 degrees of freedom)
```

Yield Response to Dicamba Dose, R1 to R2 mixed model (pooled data):

```
## Nonlinear mixed-effects model fit by maximum likelihood
##   Model: Yield ~ 1900/(19 + exp(b * (log(Dose.gha) - log(yl95))))
##  Data: dicdat.yldr
##        AIC      BIC    logLik
##   776.4365 791.5672 -382.2182
##
## Random effects:
##  Formula: list(yl95 ~ 1, b ~ 1)
##  Level: Study
##  Structure: General positive-definite, Log-Cholesky parametrization
##          StdDev       Corr
## yl95     1.232941e-05 yl95
## b        1.556378e-05 0
## Residual 1.541911e+01
##
```

```
## Fixed effects: b + yl95 ~ 1
##          Value Std.Error DF  t-value p-value
## b    0.7626696 0.1019717 84 7.479232  0.0000
## yl95 0.8895476 0.4113336 84 2.162594  0.0334
##  Correlation:
##      b
## yl95 0.95
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -2.37099010 -0.66865170 -0.07590574  0.37857106  3.11014716
##
## Number of Observations: 92
## Number of Groups: 7
```

Yield Response to Dicamba Dose, R3 to R4 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##               Estimate Std. Error t-value  p-value
## b:(Intercept)  1.26779    0.49513  2.5605 0.028347 *
## e:(Intercept) 43.53033   12.30034  3.5390 0.005366 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  16.82658 (10 degrees of freedom)
```

Relationship Between Visible Injury and Yield Reduction

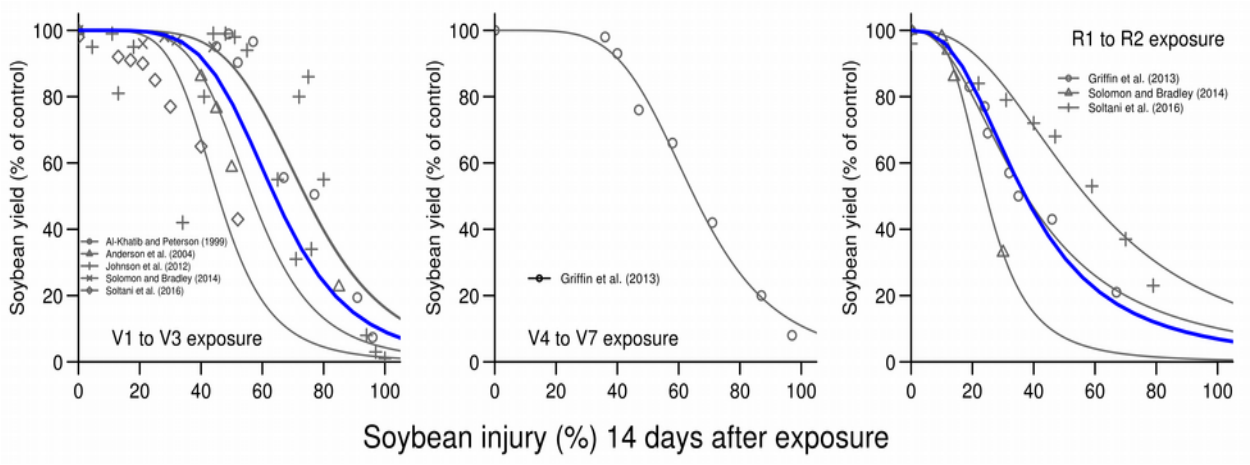

Figure S8. Relationship between visible soybean injury 14 days after exposure and soybean yield at maturity. Gray symbols & lines in each panel represent a separate study, blue lines represent the pooled data model.

Yield Relationship with Injury, V1 to V3 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##                                  Estimate Std. Error t-value   p-value
## b:Al-Khatib and Peterson (1999)   7.4061     2.4011  3.0844 0.0034804 **
## b:Anderson et al. (2004)          3.7322     1.2859  2.9025 0.0057145 **
## b:Johnson et al. (2012)           6.3584     1.7838  3.5645 0.0008773 ***
## b:Solomon and Bradley (2014)      2.5222     9.2318  0.2732 0.7859415
## b:Soltani et al. (2016)           2.5053     1.2822  1.9539 0.0569397 .
## e:Al-Khatib and Peterson (1999)  73.9174     4.1205 17.9388 < 2.2e-16 ***
## e:Anderson et al. (2004)         59.9475     6.2847  9.5386 2.236e-12 ***
## e:Johnson et al. (2012)          74.2787     2.8298 26.2487 < 2.2e-16 ***
## e:Solomon and Bradley (2014)    131.0540   545.7878  0.2401 0.8113285
## e:Soltani et al. (2016)          48.5445     9.6848  5.0125 8.825e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  16.39314 (45 degrees of freedom)
```

Yield Relationship with Injury, V1 to V3 mixed model (pooled data):

```
## Nonlinear mixed-effects model fit by maximum likelihood
##   Model: Yield ~ 1900/(19 + exp(b * (log(Injury) - log(i95))))
##  Data: dicdat.yldv3
##        AIC      BIC    logLik
##   479.5177 491.5617 -233.7589
##
## Random effects:
##  Formula: list(i95 ~ 1, b ~ 1)
##  Level: Study
##  Structure: General positive-definite, Log-Cholesky parametrization
##          StdDev    Corr
## i95      11.890607 i95
## b         1.505325 1
## Residual 15.573463
##
## Fixed effects: b + i95 ~ 1
##        Value Std.Error DF  t-value p-value
## b    5.17315  1.048347 49 4.934576       0
## i95 36.25471  6.466158 49 5.606840       0
##  Correlation:
##     b
## i95 0.919
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -3.68311340 -0.39809717 -0.05160724  0.12617390  2.49802082
##
## Number of Observations: 55
## Number of Groups: 5
```

Yield Relationship with Injury, V4 to V7 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##               Estimate Std. Error t-value   p-value
## b:(Intercept)  4.89457    0.39603  12.359 1.712e-05 ***
## e:(Intercept) 65.08030    1.26353  51.507 3.594e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  3.961769 (6 degrees of freedom)
```

Yield Relationship with Injury, R1 to R2 model output:

```
##
## Model fitted: Log-logistic (ED50 as parameter) with lower limit at 0 (2 parms)
##
## Parameter estimates:
##
##                               Estimate Std. Error t-value   p-value
## b:Griffin et al. (2013)        2.22475    0.22764  9.7730 6.753e-08 ***
## b:Solomon and Bradley (2014)   3.55845    0.44174  8.0555 7.908e-07 ***
## b:Soltani et al. (2016)        2.51659    0.28330  8.8831 2.318e-07 ***
## e:Griffin et al. (2013)       37.52015    1.37529 27.2816 3.375e-14 ***
## e:Solomon and Bradley (2014) 24.51454    1.15333 21.2554 1.304e-12 ***
## e:Soltani et al. (2016)       57.16306    1.81518 31.4916 4.028e-15 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error:
##
##  4.273485 (15 degrees of freedom)
```

Yield Relationship with Injury, R1 to R2 mixed model (pooled data):

```
## Nonlinear mixed-effects model fit by maximum likelihood
##   Model: Yield ~ 1900/(19 + exp(b * (log(Injury) - log(i95))))
##  Data: dicdat.yldr
##        AIC      BIC    logLik
##   148.3216 154.5888 -68.16082
##
## Random effects:
##  Formula: list(i95 ~ 1, b ~ 1)
##  Level: Study
##  Structure: General positive-definite, Log-Cholesky parametrization
##          StdDev    Corr
## i95      2.5465265 i95
## b        0.4395667 -0.59
## Residual 4.3746535
##
## Fixed effects: b + i95 ~ 1
##         Value Std.Error DF  t-value p-value
## b    2.632156 0.3213374 17 8.191255       0
## i95 12.156332 1.7995688 17 6.755136       0
##  Correlation:
##     b
## i95 -0.16
##
## Standardized Within-Group Residuals:
##        Min         Q1        Med         Q3        Max
## -2.1413181 -0.5138952  0.0000000  0.7004927  1.6814286
##
## Number of Observations: 21
## Number of Groups: 3
```