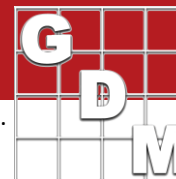


Using the Colby Equation in ARM



Utilize ARM Standard Evaluations to assess synergistic or antagonistic responses with the Colby Equation.

Setting up the Treatments

- Open **Treatments** editor
- Enter *Untreated Check* as *Treatment 1*
- Enter *Product A and B* as singular products for *Treatments 1 and 2*
- Use last treatment as combination of A and B (with same rates as individually)

| Trt Line | Trt No. | Type | Treatment Name | Form Conc | Form Unit | Form Type | Rate | Rate Unit |
|----------|---------|------|----------------|-----------|-----------|-----------|------|-----------|
| 1 | 1 | CHK | UTC | | | | | |
| 2 | 2 | HERB | Product A | 100 | g/L | SL | 50 | g AI/ha |
| 3 | 3 | HERB | Product B | 150 | g/L | SL | 75 | g AI/ha |
| 4 | 4 | HERB | Product A | 100 | g/L | SL | 50 | g AI/ha |
| 5 | 4 | HERB | Product B | 150 | g/L | SL | 75 | g AI/ha |

Standard Evaluations

COLBY COUNT

1. In **SE Definitions** editor, select *Colby Count* for **SE Name** field
2. Fill in **Part Rated** fields
3. Click **Build Headers** button in **Properties Panel**
 - Choose *Replace OR Update*
4. Open **Assessment Data** header in trial
5. Enter *pest count* for each plot in Column 1 [C1]
6. ARM calculates expected value [C2] using **ARM Action Code Tn** (user-defined → see below) and data from [C1]

Tn Calculation:

$$\text{AVGREP}([C1T2]) * \text{AVGREP}([C1T3]) / @\text{AVGREP}([C1TU])$$

7. Average the count for each replicate of *Treatment 4*
 - If $\text{AVGREP}[C1T4] < C2$, combination is synergetic (+)
 - If $\text{AVGREP}[C1T4] > C2$, combination is antagonistic (-)
 - If $\text{AVGREP}[C1T4] = C2$, combination is additive

Example:

$$\text{AVGREP}[C1T2] = 28.75$$

$$\text{AVGREP}[C1T3] = 27.5$$

$$\text{AVGREP}[C1TU] = 77.5$$

$$(28.75 * 27.5) / 77.5 = 10.2$$

The Colby Equation calculates an expected 10.2 weeds per plot after applying Treatment 2 and Treatment 3.

$$\text{AVGREP}[C1T4] = 15$$

Treatment 4 resulted in an average of 15 weeds per plot.

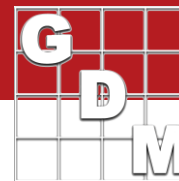
$$15 \text{ (plants)} > 10.20 \text{ (plants)}$$

The treatments combined are less effective than expected, implying **antagonism**.

| Assessment Data - Line 55 | | | | | | | | | |
|---------------------------|-------------------------|-------|--|--|-----------------------|-------|--|--|--|
| Column Number | 1 | | | | 2 (Calculated) | | | | |
| Pest Type | W | Weed | | | W | Weed | | | |
| Pest Code | 1KCHG | | | | 1KCHG | | | | |
| Pest Scientific Name | Kochia | | | | Kochia | | | | |
| Pest Name | Kochia | | | | Kochia | | | | |
| Crop Type, Code | C | TRZAS | | | C | TRZAS | | | |
| BBCH Scale | BCER | | | | BCER | | | | |
| Crop Scientific Name | Triticum aestivum | | | | Triticum aestivum | | | | |
| Crop Name | Spring wheat | | | | Spring wheat | | | | |
| SE Name | COLBY COUNT | | | | COLBY COUNT | | | | |
| SE Description | Count rating for Colby: | | | | Colby Interaction for | | | | |
| Part Rated | PLANT P | | | | PLANT P | | | | |
| Rating Type | COUNT | | | | COLCNT | | | | |
| Rating Unit/Min/Max | NUMBER | | | | NUMBER | | | | |
| ARM Action Codes | | | | | T1 N | | | | |

| | Sub | Rep | Blk | Col | Plot | Trt | 1 | 2 (Calculated) |
|--|-----|-----|-----|-----|------|-----|----|----------------|
| | 1 | 1 | 1 | 1 | 101 | 1 | 80 | 10.20 |
| | 1 | 2 | 2 | 3 | 203 | 1 | 75 | 10.20 |
| | 1 | 3 | 3 | 4 | 304 | 1 | 85 | 10.20 |
| | 1 | 4 | 4 | 1 | 401 | 1 | 70 | 10.20 |
| | 1 | 1 | 1 | 2 | 102 | 2 | 30 | 10.20 |
| | 1 | 2 | 2 | 1 | 201 | 2 | 25 | 10.20 |
| | 1 | 3 | 3 | 2 | 302 | 2 | 30 | 10.20 |
| | 1 | 4 | 4 | 3 | 403 | 2 | 30 | 10.20 |
| | 1 | 1 | 1 | 4 | 104 | 3 | 25 | 10.20 |
| | 1 | 2 | 2 | 2 | 202 | 3 | 25 | 10.20 |
| | 1 | 3 | 3 | 3 | 303 | 3 | 30 | 10.20 |
| | 1 | 4 | 4 | 2 | 402 | 3 | 30 | 10.20 |
| | 1 | 1 | 1 | 3 | 103 | 4 | 15 | 10.20 |
| | 1 | 2 | 2 | 4 | 204 | 4 | 20 | 10.20 |
| | 1 | 3 | 3 | 1 | 301 | 4 | 10 | 10.20 |
| | 1 | 4 | 4 | 4 | 404 | 4 | 15 | 10.20 |

Using the Colby Equation in ARM



COLBY % OF CTRL

1. In **SE Definitions** editor, select *COLBY % OF CTRL* for **SE Name** field
2. Fill in **Part Rated** fields
3. Click **Build Headers** button in **Properties Panel**
 - o Choose *Replace OR Update*
4. Open the **Assessment Data** header in the trial
5. Enter the *pest incidence %* for each plot in Column 3 [C3] (UTC = 100%)
6. Calculate the expected % of control using **ARM Action Code Tn** (user-defined → see below) and data from [C3]

Tn Calculation: @AVGREP([C3T2])*@AVGREP([C3T3])/@AVGREP([C3TU])

7. Average the count for each replicate of *Treatment 4*.
 - o If AVGREP[C3T4] < C4, combination is synergistic (+)
 - o If AVGREP[C3T4] > C4, combination is antagonistic (-)
 - o If AVGREP[C3T4] = C4, combination is additive

Example:

AVGREP[C3T2] = 52.5
 AVGREP[C3T3] = 70
 (52.5 * 70)/100 = 36.75

The Colby Equation calculates an expected 36.75% weed coverage of the plot after applying Treatment 2 and Treatment 3.

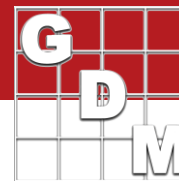
AVGREP[C3T4] = 17.5

Treatment 4 resulted in an average of 17.5% of the plot still covered in weeds.

17.5 < 36.75

The treatments combined are more effective than expected, implying **synergy**.

| Assessment Data - Line 10 | | | | | | | | | |
|----------------------------|----------------------------|-------|--|----------------------------|-------|--|--|--|--|
| Column Number | 3 | | | 4 (Calculated) | | | | | |
| Pest Type | W | Weed | | W | Weed | | | | |
| Pest Code | 1KCHG | | | 1KCHG | | | | | |
| Pest Scientific Name | Kochia | | | Kochia | | | | | |
| Pest Name | Kochia | | | Kochia | | | | | |
| Crop Type, Code | C | TRZAS | | C | TRZAS | | | | |
| BBCH Scale | BCER | | | BCER | | | | | |
| Crop Scientific Name | Triticum aestivum | | | Triticum aestivum | | | | | |
| Crop Name | Spring wheat | | | Spring wheat | | | | | |
| SE Name | COLBY % OF CTRL | | | COLBY % OF CTRL | | | | | |
| SE Description | % of Control rating (UTC=1 | | | Colby Interaction for % of | | | | | |
| Part Rated | PLANT P | | | PLANT P | | | | | |
| Rating Type | PERCEN | | | COLPOC | | | | | |
| Rating Unit/Min/Max | %DIF | | | NUMBER | | | | | |
| ARM Action Codes | | | | T3 N | | | | | |
| + Sub Rep Blk Col Plot Trt | 3 | | | 4 (Calculated) | | | | | |
| 1 1 1 1 101 1 | 100 | | | 36.75 | | | | | |
| 1 2 2 3 203 1 | 100 | | | 36.75 | | | | | |
| 1 3 3 4 304 1 | 100 | | | 36.75 | | | | | |
| 1 4 4 1 401 1 | 100 | | | 36.75 | | | | | |
| 1 1 1 2 102 2 | 50 | | | 36.75 | | | | | |
| 1 2 2 1 201 2 | 40 | | | 36.75 | | | | | |
| 1 3 3 2 302 2 | 50 | | | 36.75 | | | | | |
| 1 4 4 3 403 2 | 70 | | | 36.75 | | | | | |
| 1 1 1 4 104 3 | 65 | | | 36.75 | | | | | |
| 1 2 2 2 202 3 | 80 | | | 36.75 | | | | | |
| 1 3 3 3 303 3 | 65 | | | 36.75 | | | | | |
| 1 4 4 2 402 3 | 70 | | | 36.75 | | | | | |
| 1 1 1 3 103 4 | 15 | | | 36.75 | | | | | |
| 1 2 2 4 204 4 | 20 | | | 36.75 | | | | | |
| 1 3 3 1 301 4 | 15 | | | 36.75 | | | | | |
| 1 4 4 4 404 4 | 20 | | | 36.75 | | | | | |



COLBY % CONTROL

1. In **SE Definitions** editor, select *COLBY % CONTROL* for **SE Name** field
2. Fill in **Part Rated** fields
3. Click **Build Headers** button in **Properties Panel**
 - o Choose *Replace OR Update*
4. Open the **Assessment Data** header in the trial
5. Enter the *% control rating* for each plot in Column 5 [C5] (UTC = 0)
6. Calculate the expected % of control using **ARM Action Code Tn** (user-defined → see below) and data from [C5]

$$\text{Tn Calculation: } 100 - (((100 - @AVGREP([C5T2])) * (100 - @AVGREP([C5T3])))) / 100$$

7. Average the % control rating for each of the replicates of *Treatment 4* (Product A+B)
 - o If $AVGREP[C6T4] > C6$, combination is synergetic (+)
 - o If $AVGREP[C6T4] < C6$, combination is antagonistic (-)
 - o If $AVGREP[C6T4] = C6$, combination is additive

Example:

$$\begin{aligned} &AVGREP[C5T2] = 47.5 \\ &AVGREP[C5T3] = 52.5 \\ &100 - (((100 - 47.5) * (100 - 52.5)) / 100) \\ &100 - ((52.5 * 47.5) / 100) \\ &100 - 24.9375 = 75.0625 \end{aligned}$$

The Colby Equation calculates an expected control of 75.06% of the weeds in the plot.

$$AVGREP[C5T4] = 75.5$$

Treatment 4 resulted in an average of 75.5% of weeds controlled in the plot.

$$75.5 > 75.0625$$

The treatments combined are more effective than expected, implying **synergy**.

| Assessment Data - Line 3 | | | | | | | | | | |
|--------------------------|----------------------------|-------|--|--|--|----------------------------|-------|--|--|--|
| Column Number | 5 | | | | | 6 (Calculated) | | | | |
| Pest Type | W | Weed | | | | W | Weed | | | |
| Pest Code | 1KCHG | | | | | 1KCHG | | | | |
| Pest Scientific Name | Kochia | | | | | Kochia | | | | |
| Pest Name | Kochia | | | | | Kochia | | | | |
| Crop Type, Code | C | TRZAS | | | | C | TRZAS | | | |
| BBCH Scale | BCER | | | | | BCER | | | | |
| Crop Scientific Name | Triticum aestivum | | | | | Triticum aestivum | | | | |
| Crop Name | Spring wheat | | | | | Spring wheat | | | | |
| SE Name | COLBY % CONTROL | | | | | COLBY % CTRL | | | | |
| SE Description | % Control rating (UTC=0) f | | | | | Colby Interaction for % Co | | | | |
| Part Rated | PLANT | P | | | | PLANT | P | | | |
| Rating Type | CONTRO | | | | | COLPCT | | | | |
| Rating Unit/Min/Max | %UNCK | | | | | NUMBER | | | | |
| ARM Action Codes | | | | | | T3 N | | | | |

| + Sub | Rep | Blk | Col | Plot | Trt | 5 | 6 (Calculated) |
|-------|-----|-----|-----|------|-----|----|----------------|
| 1 | 1 | 1 | 1 | 101 | 1 | 0 | 36.75 |
| 1 | 2 | 2 | 3 | 203 | 1 | 0 | 36.75 |
| 1 | 3 | 3 | 4 | 304 | 1 | 0 | 36.75 |
| 1 | 4 | 4 | 1 | 401 | 1 | 0 | 36.75 |
| 1 | 1 | 1 | 2 | 102 | 2 | 50 | 36.75 |
| 1 | 2 | 2 | 1 | 201 | 2 | 45 | 36.75 |
| 1 | 3 | 3 | 2 | 302 | 2 | 50 | 36.75 |
| 1 | 4 | 4 | 3 | 403 | 2 | 45 | 36.75 |
| 1 | 1 | 1 | 4 | 104 | 3 | 55 | 36.75 |
| 1 | 2 | 2 | 2 | 202 | 3 | 50 | 36.75 |
| 1 | 3 | 3 | 3 | 303 | 3 | 55 | 36.75 |
| 1 | 4 | 4 | 2 | 402 | 3 | 50 | 36.75 |
| 1 | 1 | 1 | 3 | 103 | 4 | 75 | 36.75 |
| 1 | 2 | 2 | 4 | 204 | 4 | 70 | 36.75 |
| 1 | 3 | 3 | 1 | 301 | 4 | 75 | 36.75 |
| 1 | 4 | 4 | 4 | 404 | 4 | 70 | 36.75 |