# 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:**

AVGREP([C1T2])*AVGREP([C1T3])/@AVGREP([C1TU])

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

**Example:**

AVGREP[C1T2] = 28.75

AVGREP[C1T3] = 27.5

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.

AVGREP[C1T4] = 15

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

15 (plants) > 10.20 (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 (2) | 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 (6) |
| 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 (7) | 10.20 |
| 1 | 3 | 3 | 1 | 301 | 4 | 10 | 10.20 |
| 1 | 4 | 4 | 4 | 404 | 4 | 15 | 10.20 |

## 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**
   - 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.*

   - If AVGREP[C3T4] < C4, combination is synergetic (+)
   - If AVGREP[C3T4] > C4, combination is antagonistic (-)
   - 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 (2) | 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 (6) |
| | 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 (7) | 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**
   - 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]

**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)
   - If AVGREP[C6T4] > C6, combination is synergetic (+)
   - If AVGREP[C6T4] < C6, combination is antagonistic (-)
   - If AVGREP[C6T4] = C6, combination is additive

**Example:**
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
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 (2) | 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 (6) |
| | 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 (7) | 36.75 |
| | 1 | 3 | 3 | 1 | 301 | 4 | 75 | 36.75 |
| | 1 | 4 | 4 | 4 | 404 | 4 | 70 | 36.75 |