### Guidelines to Aerial Seeding

- **If fields are dry**, push seeds in.
- **If the fields are moist**, fly seeds on.

### Seeding rate adjustments, based on drilling rate

**Broadcasting** - Increase seeding rate by 25%

**Aerial Seeding** - Increase seeding rate by 30%

**Forage Seeding** - Increase seeding rate by 30%

**Precision Planting** - Decrease rate 10% to 50%

**Late Planting** - Increase seeding rate 10-20%

### For SEED BLENDS and MIXTURES

To calculate a setting for seed blends and mixtures, add index settings for quantity of each seed to be sown: Ex: To sow 2 lbs of Tillage Radish® and 10 lbs of Tillage RootMax™ Deep Root Annual Ryegrass™ use the index setting for each seed and add them together to set shifter on the proper notch. Smaller seeds like CCS Crimson Clover require no adjustments.

### Adjust calibration based on apparent seed weight.

- **INCREASE** index setting for seed lighter than average seed.
- **DECREASE** index setting for seed heavier than average seed.

Approximate guide for ideal seeding depth is 6 to 8 times the thickness of the seed.

---

### Consumer Notice

If you place this Seed Planting Guide next to your seed box charts, CHARTS ARE ONLY A GUIDE. RATES ARE AFFECTED BY SEED SIZE AND QUALITY, EQUIPMENT CALIBRATION, WHEEL SLIPPAGE, SOIL FERTILITY AND RAINFALL, ETC.  Not Rec. = Not Recommended

---

### Seed Planting Guide

**Home of the Tillage Radish®**

**Exclusive TillageMax Cover Crop Mixes**

- **TillageMax INDY™ Mix**
  - Tillage Radish® + Tillage RootMax™ + CCS Crimson Clover
  - 3 to 10 weeks before avg. first killing frost
  - .25 to 1
  - 15
  - Tall Fescue (reduce by 25%), Crested Wheat Grass (reduce by 15%) or Annual Ryegrass
  - No
  - 17
  - Kinze Brush Meter with Backing Plate (60 Cell Milo Plate)
  - 12
  - (2” in-row)

- **TillageMax BRISTOL™ Mix**
  - Tillage Radish® + Tillage RootMax™
  - 3 to 10 weeks before avg. first killing frost
  - .25 to 1
  - 12
  - Tall Fescue (reduce by 25%), Crested Wheat Grass (reduce by 15%) or Annual Ryegrass
  - No
  - 15
  - Kinze Brush Meter with Backing Plate (60 Cell Milo Plate)
  - 10
  - (1.75” in-row)

- **TillageMax DAYTONA™ Mix**
  - Tillage Radish® + CCS Crimson Clover
  - 3 to 10 weeks before avg. first killing frost
  - .25 to 1
  - 10
  - Alfalfa
  - Yes
  - 13
  - Kinze Brush Meter with Backing Plate (60 Cell Milo Plate)
  - 8
  - (1.5” in-row)

- **TillageMax DOVER™ Mix**
  - Tillage Radish® + CCS Oats
  - 3 to 10 weeks before avg. first killing frost
  - .5 to 1
  - 25
  - Oats
  - No
  - 30
  - Kinze Brush Meter with Backing Plate (60 Cell Soybean Plate)
  - 20
  - (5” in-row)

---

### Nitrogen Producing Cover Crop Legumes (specific inoculant required)

<table>
<thead>
<tr>
<th>Product</th>
<th>Weeks before avg. first killing frost</th>
<th>Seeding Depth</th>
<th>Drilled (7.5” rows)</th>
<th>Comparable Seed on Drill Chart</th>
<th>Can use small seed box?</th>
<th>Broadcast Seeding Rate Lbs/Acre</th>
<th>Precision Planting (PP) 4” in-row spacing (Refer to bag label for seeds per lb.)</th>
<th>(PP) 15” rows 4” in-row Lbs/Acre*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tillage Radish®</td>
<td>3 to 10</td>
<td>.25 to 1</td>
<td>6</td>
<td>Alfalfa (reduce by 10%)</td>
<td>Yes</td>
<td>8-10</td>
<td>Small Sugar Beet Plate</td>
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<tr>
<td>Tillage RootMax™ Certified Annual Ryegrass</td>
<td>3 to 10</td>
<td>3/8 to .5</td>
<td>12</td>
<td>Tall Fescue (reduce by 20%), Crested Wheat Grass (reduce by 10%) or Annual Ryegrass</td>
<td>Yes</td>
<td>15</td>
<td>Kinze Brush Meter with Backing Plate (60 Cell Milo Plate)</td>
<td>10 (1.5” in-row)</td>
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<tr>
<td>CCS Fridge Triticale</td>
<td>4 weeks prior to first killing frost to 6 weeks after</td>
<td>1 to 1.5</td>
<td>60</td>
<td>Wheat</td>
<td>No</td>
<td>70</td>
<td>Kinze Brush Meter - 60 cell Soybean Plate (2” in-row) White - Wheat Plate</td>
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<tr>
<td>CCS Winter Pea</td>
<td>3 to 10</td>
<td>1 to 1.5</td>
<td>40</td>
<td>Soybean</td>
<td>No</td>
<td>Not Rec.</td>
<td>Soybean Plate</td>
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<tr>
<td>CCS Crimson Clover</td>
<td>3 to 10</td>
<td>2.25 to .5</td>
<td>12</td>
<td>Crimson Clover</td>
<td>Yes</td>
<td>15</td>
<td>Not Rec.</td>
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<td>CCS Lupin</td>
<td>Sweet Blue Lupin</td>
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<td>1.5</td>
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<td>CCS Hairy Vetch</td>
<td>2 to 10</td>
<td>.5 to 1.5</td>
<td>40</td>
<td>Vetch or Sorghum</td>
<td>No</td>
<td>20</td>
<td>Small Sugar Beet Plate</td>
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<tr>
<td>CCS Sunn Hemp</td>
<td>Anytime after frost free date in Spring/8 weeks prior to killing frost in Fall</td>
<td>.5 to 1</td>
<td>15</td>
<td>Wheat</td>
<td>No</td>
<td>Not Rec.</td>
<td>Small Sugar Beet Plate</td>
<td>9</td>
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</tbody>
</table>

**IMPORTANT:** CHARTS ARE ONLY A GUIDE. RATES ARE AFFECTED BY SEED SIZE AND QUALITY, EQUIPMENT CALIBRATION, WHEEL SLIPPAGE, SOIL FERTILITY AND RAINFALL, ETC.

* Use the 15” rows as a reference for alternating rows.

**Kinze Brush Meter**- 7878 Milo Plate, D7879 Soybean Plate

**Small Sugar Beet Plate**- John Deere Pro or MaxEmerge Vacuum-A51712 (increase speed by 35%), Kinze Edge Vac-D17050, Kinze Brush Meter-GA5795, White-854047, Case/IH 1200 Series-236027A2 (Old Milo Drums improve population), Monosem-6020, Precision Planting (eSet Disc-720220 (run vacuum at 15")
Cover Crop Solutions is the North American leader in the research, development and supply for cover crop seeds. Cover crops is all we do. This makes us the preferred source for farmers who rely on solid science, on-farm real world research and who want advice from a farmer who knows the challenges that you face, especially that bottom line.

Our focus is providing superior varieties, like the legendary Tillage Radish® and Tillage RootMax™ Deep Root Annual Ryegrass™ and Tillage Sunn™ (sunn hemp).

TillageMax cover crop mixes are preferred by many farmers because they add biodiversity and amazing synergies that only nature can produce. TillageMax Mixes help multiply the benefits of cover crops, giving farmers more bang for the buck in most cases.

TillageMax Mixes include exclusive varieties and highly controlled production quality. They are truly something special, grown to the highest possible quality standards to give you exceptional value for building soil health and a host of other high value benefits.

**TillageMax Cover Crop Mix Selection Guide**

<table>
<thead>
<tr>
<th>WHAT DO YOU WANT TO ACCOMPLISH?</th>
<th>INDIY</th>
<th>BRISTOL</th>
<th>DAYTONA</th>
<th>DOVER</th>
<th>CHARLOTTE</th>
<th>TALLADEGA</th>
<th>HOMESTEAD</th>
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<tbody>
<tr>
<td>N fixation</td>
<td><img src="indypass" alt="rating" /></td>
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</tbody>
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*With proper management  Note: The names of TillageMax Mixes are only trademarks when used in conjunction with the term TillageMax. Thus, TillageMax INDIY™ is a trademark of Cover Crop Solutions, Inc. No claim is made on the term “INDIY” or any other equivalent name or terms in the product line.
**INDY**

**A Great 3-Way Mix For Deep Rooting and Proven Yield Improvements**

INDY achieves a bundle of benefits, starting with the amazing Tillage Radish® taproot that drills right through tough compaction, and Tillage RootMax™ Deep Root Annual Ryegrass™ with its fibrous roots that are renowned for building soil structure. Add the nitrogen fixing advantages of CCS Crimson Clover and you have an outstanding option for getting more out of your cover crop program.

**Planting:** Plant 3-10 weeks prior to first killing frost

**Seeding Depth:** 0.25 - 1”

Comparable seed on Drill chart is Tall Fescue (reduce by 25%), Crested Wheat Grass (reduce by 15%), Annual Ryegrass

**Seeding Rate:**
- Drilling: 15 lbs/acre
- Broadcast / Aerial: 17-20 lbs/acre
- Precision Planting (15” with 2” in-row): 12 lbs/acre
  (Kinze Brush Meter with Backing Plate - 60 Cell Milo Plate)

**Control:** Tillage Radish® winter kills with 3 nights in the mid-teens. Tillage RootMax™ and CCS Crimson Clover require a burnout of two quarts of glyphosate with one pint of 2,4-D. Best control is achieved spraying on a warm day between 9 am - 4 pm with water adjusted to 5.5 ph.

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**BRISTOL**

**For Deepest Rooting, Soil Structure And N Capture**

In the BRISTOL mix, Tillage Radish® breaks up soil compaction with its aggressive taproot, creating thick channels 30” or deeper. This unique nitrogen storage tank holds N and other nutrients over winter and releases them as needed by following cash crops.

Tillage RootMax™ Deep Root Annual Ryegrass™ builds soil structure deeper than many other ARG varieties. In combination, this outstanding cover crop mixture provides added cover in the spring prior to burnout.

**Planting:** Plant 3-10 weeks prior to first killing frost

**Seeding Depth:** 0.25 - 1”

Comparable seed on Drill chart is Tall Fescue (reduce by 25%), Crested Wheat Grass (reduce by 15%), Annual Ryegrass

**Seeding Rate:**
- Drilling: 12 lbs/acre
- Broadcast / Aerial: 15-17 lbs/acre
- Precision Planting (15” with 1.75” in-row): 10 lbs/acre
  (Kinze Brush Meter with Backing Plate - 60 Cell Milo Plate)

**Control:** Tillage Radish® winter kills with 3 nights in the mid-teens. If it does not winter kill, add one pint of 2,4-D type herbicide. Tillage RootMax™ requires a burnout of two quarts of glyphosate. Best control is achieved spraying on a warm day between 9 am - 4 pm with water adjusted to 5.5 ph.
**TillageMax DAYTONA™**
Tillage Radish® + CCS Crimson Clover Mix

**For Optimal N Scavenging and Fertilizer Reduction**

This high performance DAYTONA mix delivers benefits of Tillage Radish®, the only proven yield-boosting cover crop radish, and absorbs soil nitrogen and other key nutrients with its unique taproot that grows 30” and deeper.

CCS Crimson Clover converts atmospheric nitrogen into plant available nitrogen, helping reduce fertilizer input while improving soil health by adding organic matter. Maximum nitrogen is achieved at first flower of CCS Crimson Clover.

**Planting:** Plant 3-10 weeks prior to first killing frost  
**Seeding Depth:** 0.25 - 1”  
Comparable seed on Drill chart is Alfalfa. Small seed box can be used  
**Seeding Rate:**  
- **Drilling:** 10 lbs/acre  
- **Broadcast / Aerial:** 13-15 lbs/acre  
- **Precision Planting (15” with 1.5” in-row):** 8 lbs/acre  
  (Kinze Brush Meter with Backing Plate - 60 Cell Milo Plate)  
**Control:** Tillage Radish® winter kills with 3 nights in the mid-teens. CCS Crimson Clover can be controlled by a spring burndown with one pint of 2,4-D type herbicide along with one quart glyphosate.

---

**TillageMax DOVER™**
Tillage Radish® + CCS Oats Mix

**An Ideal Mix for Quick Fall Cover and Spring Ground Cover**

Both excellent scavengers of N, DOVER combines Tillage Radish® and CCS Oats in this mix that grows rapidly in cool weather and is ideal for quick fall cover.

Tillage Radish® breaks up soil, even in the compaction zone, with its long, singular taproot to create thick channels 30” or deeper. This mix enhances seedbeds, provides more ground cover in spring, helps control erosion, works to help control harmful nematodes, and will winter kill for easy spring management.

**Planting:** Plant 3-10 weeks prior to first killing frost  
**Seeding Depth:** 0.5 - 1”  
Comparable seed on Drill chart is Oats  
**Seeding Rate:**  
- **Drilling:** 25 lbs/acre  
- **Broadcast / Aerial:** 30-45 lbs/acre  
- **Precision Planting (15” with 5” in-row):** 20 lbs/acre  
  (Kinze Brush Meter with Backing Plate - 60 Cell Soybean Plate)  
**Control:** Winter kills after 3 nights in the mid-teens. If Tillage Radish® or CCS Oats does not winter kill, apply a combination of one pint of 2,4-D type herbicide along with one quart of glyphosate at flowering or heading.
**For deepest rooting, soil structure and N Capture**

In the CHARLOTTE cover crop mix, Tillage Radish™ breaks up soil compaction with its aggressive taproot, creating thick channels 30” or deeper. This unique nitrogen storage tank holds N and other nutrients over winter and releases them as needed by following cash crops.

CCS Fridge Triticale soaks up additional N in the fall as well as in the spring, keeping any N from leaching until a cash crop can utilize it. CCS Crimson Clover adds up to 50 lbs of additional N in the spring.

**Planting:** Plant 3-10 weeks prior to first killing frost

**Seeding Depth:** 1”

Comparable seed on Drill chart is Wheat

**Seeding Rate:**
- Drilling: 40 lbs/acre
- Broadcast / Aerial: 50 lbs/acre
- Precision Planting (15” with 1.5” in-row): 8 lbs/acre

(Kinze Brush Meter with Backing Plate - 60 Cell Plate)

**Control:** It is recommended to control when Fridge Triticale reaches 18” in height. Use 1 quart of glyphosate and 1 pint of a 2-4D product which will control, Fridge Triticale, CCS Crimson Clover and any Tillage Radish that may not have been winter killed.

---

**Get Easy Control and Aggressive Spring Biomass**

TALLADEGA achieves a bundle of benefits, starting with the amazing Tillage Radish® taproot that drills right through tough compaction. The winter hardy Fridge Triticale excels at soaking up any left over N from a previous crops or manure application. Can be used as a forage by doubling the seeding rates. This is the mix you need where it is certain there is plenty of N or you have nutrients in manure you want to catch in the fall and release in the spring.

**Planting:** Plant 3-10 weeks prior to first killing frost

**Seeding Depth:** 1”

Comparable seed on Drill chart is Wheat

**Seeding Rate:**
- Drilling: 40 lbs/acre
- Broadcast / Aerial: 50 lbs/acre
- Precision Planting (15” with 2” in-row): 30 lbs/acre

(Kinze Brush Meter with Backing Plate - 60 Cell Soybean Plate)

**Control:** It is recommended to control when Fridge Triticale reaches 18” in height. Use 1 quart of glyphosate and add 1 pint of a 2-4D product which will control any Tillage Radish that may not have been winter killed.
**Perfect for Prevent Acres, Nematode Suppression, Restoring & Building Soil Health**

A true soil builder, HOMESTEAD helping restore soil health following challenging conditions like extended drought or flood. Tillage Sunn™ is a tropical warm weather legume that thrives in dry conditions and poor soil, and suppresses nematodes. It can produce over 60 lbs of N in 6 weeks! CCS Pearl Millet adds plenty of biomass both in above ground and with its roots. Tillage Radish is shaded by the two taller species during the summer and then springs to life at the first sign of cooler weather, soaking up massive amounts of N the Tillage Sunn produced and storing it for when the newly planted spring cash crop needs it most. Ideal for planting during the summer after small grains, prevent planting acres, or early harvested vegetable crops.

**Planting:** Late spring to 8 weeks before the first frost

**Seeding Depth:** 1”

Comparable seed on Drill chart is =Wheat

**Seeding Rate:**
- **Drilling:** 15 lbs/acre
- **Broadcast / Aerial:** 17-20 lbs/acre
- **Precision Planting (15” with 2” in-row):** 12 lbs/acre
  (Kinze Brush Meter with Backing Plate - 60 Cell Soybean Plate)

**Control:** Tillage Sunn and CCS Pearl Millet kill with the first frost. Tillage Radish is winter killed with a few nights in the mid-teens. A quart of glyphosate and 1 pint of a 2-4D product will control any Tillage Radish that may not have been winter killed.

Learn more about TillageMax Mixes featuring Tillage Radish® at:

TillageRadish.com
ABOUT US

Cover Crop Solutions is a seed company that stands for something new in agriculture, a fresh approach to cover cropping and how they can make a positive contribution to the farm’s bottom line.

Steve Groff, recognized worldwide for his innovation and enthusiasm for cover crops, knows all about how they enhance soils and improve farming sustainability. He notes, “Good things happen when we work in harmony with nature. For us, we believe soil is meant to be covered, and the practical results of that belief are what we’re all about.”

Ask us to show you how cover crops are proven to reduce input costs without compromising high yields, and why we produce and supply “cover crops that pay.”

Cover crops are our sole focus, so in addition to developing our own unique varieties, we also search high and low for the finest and most outstanding high performance cover crops available. Trust Cover Crop Solutions for great genetics and highest quality cover crop seed, and far more value for every dollar.

LEADING PRODUCTS

The legendary radish that paved the way to an entirely fresh look at cover crops and how they add to the bottom line. There are no substitutes for the original certified Tillage Radish®.

A unique variety of annual ryegrass developed specially for use in cover crop applications. Certified genetic purity in every bag, massive tillering and root system, plus uniform emergence and growth for easier control.

This fabulous warm season legume does wonders in restoring poor soil and adding biomass. As a tropical plant, control is automatic in climates where temperature reaches freezing.

Additional Cover Crops

Winter Pea  Cereal Rye
Crimson Clover  Fridge Triticale
Hairy Vetch  Phacelia*

* Requires pre-order
Cover crops have become a major topic for producers who want to capitalize on government conservation payments and incorporate sustainable agriculture practices into crop production acres. Cover crops can decrease soil erosion, enhance soil quality and nutritive value, and help improve air and water quality. Cover crops are unique in that most are planted primarily for these benefits and are not harvested for their seed, fruit, or forage (some are partially grazed or used as forage). Instead, cover crops are terminated before planting production crops.

Those who would like to use cover crops in their production systems have many factors to consider including how the cover crop will be terminated. If not terminated properly, cover crops have the potential to become weeds in the production crop and can slow soil drying and warming in the spring. Many cover crop species have characteristics that make them both desirable as cover crops and troublesome weed species. Weedy cover crop escapes not only affect the current production crop, but also can produce seeds and establish a seed bank that will produce future weed problems.

This publication describes how producers can effectively terminate cover crops with herbicides to prevent them from becoming weeds in production crops.

**Termination Methods**

The four common methods of terminating cover crops are: winterkilling, tilling, mowing, and applying herbicides.

Oats can be an effective cover crop. Each method has its disadvantages and limits. For example, winterkill (the cover crop is terminated by a hard freeze) is only applicable to certain crops and climate regions; mowing is limited to certain cover crops and crop growth stages. Tillage can be expensive and can negate the benefits of the cover crops, as well as the benefits of minimum/no-till production systems.

Many factors also limit herbicides — and they may be completely prohibited in organic cropping systems. When selecting an herbicide program for termination of a cover crop, consider:

- The cover crop species.
- The cover crop growth stage.
- Other weed species present.
- The production crop to be planted.
- The weather conditions at application.
- The type of herbicide used.
**Cover Crop Species**

The *Midwest Cover Crops Field Guide* (Purdue Extension publication ID-433) splits cover crop species into three categories: grasses, legumes, and other non-legume broadleaves (the guide is available from the Education Store, www.the-education-store.com).

Cover crop systems that contain only grass species or only broadleaf species can be terminated using selective grass or broadleaf herbicides. However, producers will often grow combinations of grass and broadleaf species from the three groups together to receive the maximum benefits that each group presents. Successfully terminating a mixed cover crop that contains grasses and broadleaves will require a nonselective herbicide such as glyphosate, glufosinate (Liberty®), or paraquat (Gramoxone®).

While it is possible to combine a selective grass herbicide and selective broadleaf herbicide to terminate a mixed crop, this practice is not advisable because combinations can be antagonistic. Combining glyphosate with either 2,4-D or dicamba can ensure more complete termination of broadleaf species than spraying glyphosate, 2,4-D, or dicamba alone.

Effective herbicide control of grasses and broadleaves varies by species. You should always consult a weed control guide or herbicide label to ensure the herbicide will be effective on a particular cover crop species. See Species-specific Recommendations (page 4) for herbicide programs for some common cover crops. For details about weed control, consult the *Weed Control Guide for Ohio and Indiana* (Purdue Extension publication WS-16-W) available from the Education Store, www.the-education-store.com.

**Cover Crop Growth Stage**

The growth stage and height of the cover crop at the time of termination is critical in determining what herbicide and rate will be most effective. Crops that are bolting, jointing, or producing reproductive structures can be difficult to control with herbicides and may require other termination methods. Always take cover crop heights into consideration because taller, more mature plants may require greater herbicide rates than smaller, less mature plants.

**Other Weed Species Present**

One of the potential benefits of cover crops is that they can suppress some winter annual weed species. However, poor cover crop stands, unintended winterkill, and seed contamination can make room for weed species to infest cover crops.

Before choosing an herbicide to terminate a cover crop, carefully consider all the plant species that are present— including cover crops and weeds. Decide on an herbicide plan before planting or seeding the cover crop, and then amend the plan according to any additional weed species that occur.

**Production Crop to Be Planted**

When considering a cover crop and termination plan, consider the production crop you will plant after the cover crop. Many herbicides persist in soil and plant residues, which can harm or kill the following production crop.

When planning an herbicide termination program, use only herbicides that are labeled for burndown or preplant applications with the production crop you will plant. Be sure you also observe planting restrictions. For example, there is a 14-day restriction when planting soybean after using high rates of 2,4-D in your cover crop termination program. Table 1 lists the planting restrictions for corn and soybean planting for selected herbicide products.
Successful Cover Crop Termination with Herbicides

Table 1. Corn and soybean planting restrictions for herbicides used to terminate cover crops.

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Trade Name</th>
<th>Planting Restriction¹</th>
<th>Corn</th>
<th>Soybean</th>
</tr>
</thead>
<tbody>
<tr>
<td>atrazine</td>
<td>AAtrex®</td>
<td>NR</td>
<td>10 months</td>
<td></td>
</tr>
<tr>
<td>S-metolachlor + glyphosate</td>
<td>Sequence®</td>
<td>NR</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>atrazine + S-metolachlor + glyphosate</td>
<td>Expert®</td>
<td>NR</td>
<td>10 months</td>
<td></td>
</tr>
<tr>
<td>glyphosate</td>
<td>Roundup®, Touchdown®, others</td>
<td>NR</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>paraquat</td>
<td>Gramoxone®</td>
<td>NR</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>2,4-D ester</td>
<td></td>
<td>NR</td>
<td>0.5 lb ai/A: 7 days</td>
<td>1.0 lb ai/A: 14 days</td>
</tr>
<tr>
<td>dicamba</td>
<td>Clarity®</td>
<td>NR</td>
<td>8 fl oz/A: 14 days</td>
<td>16 fl oz/A: 28 days</td>
</tr>
<tr>
<td>fomesafen + glyphosate</td>
<td>Flexstar GT®</td>
<td>10 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>chlorimuron + tribenuron</td>
<td>Canopy EX®, Cloak EX®</td>
<td>10 months</td>
<td>1.1-2.2 oz/A: 7 days</td>
<td>2.3-3.3 oz/A: 14 days</td>
</tr>
<tr>
<td>chlorimuron + thifensulfuron</td>
<td>Synchrony XP®</td>
<td>10 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>chlorimuron + metribuzin</td>
<td>Canopy®, Cloak DF®</td>
<td>10 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>chlorimuron + thifensulfuron + flumioxazin</td>
<td>Envive®</td>
<td>10 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>chlorimuron + flumioxazin</td>
<td>Valor XLT®</td>
<td>10 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>chlorimuron + sulfentrazoone</td>
<td>Authority XL®</td>
<td>10 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>chloransulam</td>
<td>FirstRate®</td>
<td>9 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>chloransulam + sulfentrazoone</td>
<td>Authority First®, Sonic®</td>
<td>10 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>chloransulam + flumioxazin</td>
<td>Gangster®</td>
<td>9 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>saflufenacil²</td>
<td>Sharpen®</td>
<td>NR</td>
<td>≤1 oz/A: NR</td>
<td>&gt;1 oz/A: 14 days</td>
</tr>
<tr>
<td>saflufenacil² + imazethapyr</td>
<td>Optill®</td>
<td>8.5 months</td>
<td></td>
<td>NR</td>
</tr>
<tr>
<td>saflufenacil² + dimethenamid-P</td>
<td>Verdict®</td>
<td>NR</td>
<td>5 oz: NR</td>
<td></td>
</tr>
<tr>
<td>saflufenacil² + dimethenamid-P + imazethapyr</td>
<td>Optill PRO®</td>
<td>8.5 months</td>
<td>5-10 oz/A: 4 months</td>
<td>&gt;10 oz/A: 9 months</td>
</tr>
</tbody>
</table>

¹NR=no planting restrictions — this herbicide may be applied up to crop planting.

²Saflufenacil products being applied to course soils with ≤2% organic matter should be applied 30 days prior to soybean planting.
Weather Conditions at Application
Environmental conditions affect herbicide applications, and unfortunately, these are factors that producers cannot control or predict. Typically, cover crop terminations take place in the early spring, so while the exact weather may vary, conditions tend to be cold to mild with variable cloudiness and high moisture.

Take these typical weather conditions into account when planning an herbicide termination program — cool, cloudy conditions slow the rate that herbicides kill plants. The effect of temperature is especially striking with translocated herbicides, because plants must be actively growing to move the herbicide to its site of action. Wet soil can also keep sprayers out of fields, which delays applications and allows cover crops to reach undesirable heights and growth stages.

Type of Herbicide Used
Herbicides are generally divided into two groups: contact or translocated.

Contact herbicides are not transported throughout the plant, so they only affect the parts of the plant they come into contact with. This can be an advantage because the cooler temperatures won’t limit herbicide activity; however, a successful application will require complete foliar coverage. Complete coverage will be especially difficult in mixed cover crop stands because of the different plant sizes and shapes.

Translocated herbicides are transported in plants to their growing points and sites of action. These herbicides rely on plants’ transport systems to gain access to the site of action — this eliminates the need for complete application coverage. However, as mentioned earlier, the rate that translocated herbicides kill plants depends on the plants’ metabolism, which is slower during spring’s typically cooler temperatures.

Species-specific Recommendations
A large variety of cover crop species are available and recommended for specific cropping systems, soil types, and regions. This section provides herbicide termination recommendations for the cover crop species most commonly recommended in Indiana.

Annual Ryegrass
Annual ryegrass (*Lolium multiflorum*), also called Italian ryegrass or common ryegrass, has become a very popular cover crop throughout the Midwest. Do not confuse annual ryegrass with cereal rye (*Secal cereale*). Annual ryegrass can be an ideal cover crop because of its ability to rapidly germinate in the fall, grow aggressively in the spring, and add substantial root and forage mass to the soil profile.

However, this plant’s aggressive and competitive nature makes it a potential weed problem in production crops. The introduction of annual ryegrass as a cover crop in Indiana and the possibility of it escaping as a weed is a concern. Annual ryegrass has established itself as a weed in orchards, vineyards, and grain crops throughout the western and southern United States and is recognized by multiple scientific weed societies as an invasive weed species. Annual ryegrass is also able to quickly adapt to herbicide selection pressure. The international weed survey (Heap 2012) reports herbicide-resistant annual ryegrass populations in ten states and across six herbicide modes of actions.

While you should take care when planning the termination for any cover crop, you should be especially vigilant when planning a termination application for a cover crop that includes annual ryegrass. Follow these guidelines for successful termination of annual ryegrass cover crops:

- Apply herbicides when annual ryegrass plants are no taller than 6 inches.
- Increase the herbicide rate if applying to annual ryegrass that is taller than 6 inches.
- Make all efforts to terminate the annual ryegrass crop prior to jointing.
- Use translocated herbicides to achieve complete ryegrass termination, including the plant’s underground reproductive structures.

Table 2 provides annual ryegrass control ratings for selected herbicides.
Table 2. Annual ryegrass response to corn and soybean burndown herbicides.\(^1\)

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Trade Name</th>
<th>Annual Ryegrass Control(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>atrazine</td>
<td>AAtrex(^*)</td>
<td>5</td>
</tr>
<tr>
<td>S-metolachlor + glyphosate</td>
<td>Sequence(^*)</td>
<td>6</td>
</tr>
<tr>
<td>atrazine + S-metolachlor + glyphosate</td>
<td>Expert(^*)</td>
<td>6</td>
</tr>
<tr>
<td>glyphosate</td>
<td>Roundup(^<em>), Touchdown(^</em>), others</td>
<td>7</td>
</tr>
<tr>
<td>paraquat</td>
<td>Gramoxone(^*)</td>
<td>6</td>
</tr>
<tr>
<td>fomesafen + glyphosate</td>
<td>Flexstar GT(^*)</td>
<td>7</td>
</tr>
<tr>
<td>paraquat + atrazine(^3)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)Control scale: 8-9=good. 6-7=fair. 5-0=poor.

\(^2\)Annual ryegrass control numbers derived from Chemical Control of Weeds for Kentucky Grain Crops (University of Kentucky Extension publication AGR-6). All herbicides applied at a standard rate typical for a corn or soybean burndown. To attain additional control, raise the herbicide rate to the maximum feasible labeled rate.

\(^3\)Paraquat+atrazine is not available as a prepackaged herbicide. The treatment listed is a tank mix at standard rates.

**Cereal Rye and Oats**

Two popular grass species used as cover crops are cereal rye and oats. These grass species are less competitive than annual ryegrass and more readily controlled by burndown herbicides. Glyphosate (4.5 lb ae/gal formulation) at a rate of 22 fl oz/A will effectively control both species up to 18 inches tall, although applications should be made to smaller plants when possible and prior to the boot stage. Tank mixes of glyphosate plus 2,4-D, chlorimuron, chloransulam, atrazine, or saflufenacil can also be applied for additional control of other cover crop species (specifically broadleaf species) and will provide residual activity against summer annual broadleaf weeds. The nonselective herbicides parquat and Liberty\(^*\) will also control cereal rye and oats, but may not be as effective as glyphosate under spring weather conditions.

**Crimson Clover and Austrian Winter Peas**

Crimson clover and Austrian winter peas are two popular legume species used as cover crops that typically do not winterkill and require a spring termination. Escapes and failed control of crimson clover and Austrian peas have been documented as rare, so they pose less threat as potential weed species in production crops than annual ryegrass.

Herbicide control data for these two species are limited; however, cover crop guides advise that herbicides easily control crimson clover and winter peas. Standard rates of glyphosate, 2,4-D, and combinations of glyphosate and 2,4-D should achieve acceptable termination of these cover crops species.

Producers considering cover crops need to consider a variety of factors when planning an herbicide termination application. Producers should keep the following factors in mind: cover crop species, other weed species present, cover crop growth stage, herbicide plant back restrictions, and spring weather conditions. The benefits of a cover crop can be quickly negated if producers fail to properly manage cover crops and allow weedy escapes, especially with cover crops species like annual ryegrass.

**References and Citations**


Successful Cover Crop Termination with Herbicides


Find more publications in the *Terminating Cover Crops* series at the Purdue Extension Education Store: www.the-education-store.com.

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