# 2022 Herbicide Guide for Iowa Corn and Soybean Production

## Designing Resilient Weed Management Programs

Herbicide-resistant weeds continue to spread rapidly across Iowa, threatening the sustainability of current herbicide-based weed management programs. Weed populations with resistance to multiple herbicide groups pose the biggest threat. More than 90% of waterhemp populations collected in Iowa fields in 2019 were confirmed multiple-resistant to three herbicide groups (HGs 2, 5, and 9). Nearly 30% of populations had stacked resistance to five herbicide groups (HGs, 2, 5, 9, 14, and 27) at the recommended field-use rates. Giant ragweed and horseweed (marestail) are the other two major glyphosate-resistant weeds in Iowa corn and soybean. Weeds will continue to evolve resistance to herbicides as long as growers are heavily dependent on chemical weed control.

For most growers, diversifying herbicide programs will be the simplest and most important strategy for managing herbicide resistance. Resilient programs rely on multiple herbicide groups that are effective against important weeds present in the field. Knowledge of the individual herbicide included in the program is essential in achieving success. The herbicide use rate is critical in determining its effectiveness; ensure the individual components of a program are used at rates that will control target weeds. Other factors that determine the effectiveness of an herbicide program include: 1) the nature of the weed infestation in the field, including species present, density of weeds, existing herbicide-resistant weed populations, 2) ability to spray the field in a timely fashion (i.e. availability of sprayer, number of acres managed, etc.), and 3) opportunity for implementing non-chemical weed control tactics.

It is important to recognize relying solely on herbicides most likely will fail at winning the war against herbicide resistance. This article provides a brief overview of the types of herbicide strategies used in corn and soybean production, including the description of the strengths and weaknesses. The article concludes with a description of alternative strategies that provide opportunities to enhance weed control and protect the value of herbicides.

### Total Preemergence Program

*Advantages:*

- Offers the opportunity for a one-pass program. Not appropriate for most fields

*Disadvantages:*

- Inability of most herbicides to sustain effective control until the crop canopy develops.
- Reliance on timely rainfall to activate herbicides before weeds begin germination.

Only appropriate for fields with low-to-moderate densities of annual weeds.

Not appropriate for fields with high weed densities or significant populations of large-seeded broadleaves (e.g. giant ragweed, cocklebur, morning glories) or perennial weeds. The prolonged emergence pattern of waterhemp decreases the likelihood of success in fields with moderate to high densities of this weed. Early planting results in the need for extended longevity of control due to slow crop emergence, reducing the likelihood of success. Greater likelihood of success in corn than in soybean due to characteristics of available herbicides and more rapid canopy development.

***Approaches:*** This type of program typically relies on a combination of herbicides to provide broad-spectrum weed control. The herbicides must be persistent and be used at full rates in order to extend control late into the season. Split applications of the preemergence program often are used in conservation tillage systems.

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IOWA STATE UNIVERSITY
Extension and Outreach

WC94 Revised July 2022

Typically, 50-60% of the product is applied several weeks ahead of planting to control weeds that emerge prior to planting and reduce the need for timely rainfall, and the remainder is applied at or shortly after planting. This strategy can extend the activity of the herbicide later into the season, rather than if it all is applied early.

## Total Postemergence Program

*Advantages:*

- Eliminates need to spray fields during planting season, therefore, reducing labor load.

*Disadvantages:*

- Risk of significant yield loss due to early-season competition if first application is delayed.
- Many total post programs place high selection pressure on weeds for herbicide resistance.

Only appropriate for fields with low weed densities to reduce the risk of early-season competition. Best suited for growers with own sprayer so they have more control of when fields are sprayed.

***Approaches:*** Two approaches typically are used for total post programs. The introduction of Roundup Ready crops led to the popularity of sequential applications made two to three weeks apart. The other strategy is to include a residual herbicide with an early postemergence application. Halex GT is an example of the second strategy; it is a premix of glyphosate, S-metolachlor and mesotrione. Glyphosate and mesotrione would control weeds that are present at the time of the postemergence application, while the S-metolachlor and mesotrione components would control weeds that emerge after the application. A risk with this approach is the application typically is made during periods of peak weed emergence. A lack of rain to activate the preemergence herbicide within 5-7 days of application can result in weed escapes early in the season.

## Preemergence followed by Postemergence Program

*Advantages:*

- Provides most consistent control across a broad range of environmental conditions.
- Preemergence component protects yield from early-season competition.
- Easily incorporates multiple herbicide groups, therefore, reducing selection pressure.

*Disadvantages:*

- Requires multiple applications and the associated costs.

Appropriate for any weed infestation, takes advantage of the benefits of both preemergence and postemergence herbicides.

***Approaches:*** There is considerable flexibility in these programs based on the nature of the weed infestation. In fields with low to moderate grass infestations, the preemergence component can target the grasses while the focus of the postemergence component would be the broadleaf weeds. Programs providing redundant control of target weeds with the PRE and POST components will provide the most consistent weed control and best management of herbicide resistance.

Addition of a group 15 herbicide with the postemergence application can extend residual control until after the crop canopy closes. This probably is the best approach for maintaining full season control of waterhemp in soybean. The postemergence application should be applied approximately 21 to 28 days after planting, while the preemergence herbicide is still active.

## Burndown Programs for No-Till

In no-till systems, it is essential to control emerged weeds prior to crop emergence. Delaying the burndown application until after planting results in significant risk if weather or other factors result in weeds being present when the crop emerges. The particular herbicide program used is dictated largely by the presence of winter annual and perennial weeds. In fields with heavy winter annual pressure or history of problems in managing these weeds in the spring, a fall application of an appropriate herbicide may be advantageous.

**Glyphosate** is the standard for burndown herbicides due to its broad-spectrum activity on annual and perennial weeds. Long-term control of most perennial weeds is reduced with preplant applications due to insufficient weed growth to result in translocation to underground structures. Activity of glyphosate on dandelion and some winter annuals can be very slow during cool temperatures in the spring, and fall applications may provide better control of these weeds in fields with heavy infestations. The addition of 2,4-D ester to glyphosate will improve control of marestail (horseweed), giant ragweed and many mustard species.

**2,4-D ester** most often is used in combination with other herbicides to improve activity on emerged broadleaf weeds, specifically marestail, giant ragweed, and mustards. While 2,4-D has limited soil activity due to rapid microbial degradation, applications made prior to planting corn or soybean can cause significant injury. Ester formulations have less stringent restrictions on preplant applications than amines, due to the shorter half-life and lower soil availability of ester products. In soybean, applications of up to 0.5 lb. ae/A must be applied at least seven days prior to planting.

Restrictions for preplant applications for corn vary among labels, but an example would be 7 days prior to planting for up to 0.5 lb. ae/A and 14 days for 0.5-1.0 lb. ae/A. There is no planting restriction when using 2,4-D formulations registered for use on Enlist crops (Enlist One, Enlist Duo).

**Liberty** and **paraquat** are burndown options for fields where preplant weed infestations are limited to small annual weeds. Both products are contact herbicides and excellent coverage is required for good control. Best control is achieved when applied during warm, sunny conditions. The addition of 2,4-D to both of these products can improve control of broadleaf weeds, whereas addition of a group 5 herbicide (triazines) enhances activity of paraquat.

**Dicamba** may be used in combination with glyphosate or other herbicides to improve activity on certain broadleaf weeds. On non-dicamba resistant soybean, a minimum of 14 days between an application of 0.25 lb./A and planting is required, in addition to at least one inch of rainfall. No delay is required with preplant applications to Xtend soybean when using products registered for use on dicamba-resistant soybean.

**Residual herbicides with foliar activity.** Many products used for preemergence control have foliar activity (e.g. herbicide groups 2, 5, 14, and 27). In fields with low to moderate infestations of small annual weeds at planting, these herbicides may have sufficient activity at planting to control the emerged weeds. The potential for omitting specific burndown herbicides (i.e. glyphosate) is dependent upon making early-spring applications before annuals reach sizes that are tolerant of these herbicides. Saflufenacil (Kixor products) has good activity on small marestail. It may be substituted for 2,4-D in burndown programs where it is preferred not to delay planting following the burndown application.

## Non-herbicidal strategies

While herbicides will remain the primary tactic used to manage weeds for most growers, it is essential to evaluate opportunities to include non-chemical tactics into the production system. Herbicide-resistant weeds continue to spread rapidly across Iowa. Therefore, sustaining the current production system is dependent on incorporating alternative management strategies that reduce the reliance on herbicides. The suitability of these tactics varies widely among operations, but inclusion of any alternative strategy can greatly improve performance of herbicides and delay the onset of herbicide resistance.

## Mechanical control

Both preplant and postplant tillage significantly affect weed communities. A primary effect of seedbed preparation tillage is its influence on weed seed distribution within the seedbank. Due to waterhemp's small seed, tillage can bury a significant amount of the seed at a depth where the seed will not germinate. This can reduce the population that emerges after planting and simplify weed control during that season. This practice may be especially useful in years following control failures where high numbers of weed seed were produced and deposited on the soil surface. However, burying seed within the profile puts these into "long-term storage" since seeds are much longer-lived when buried deep in the profile. If this strategy is used repeatedly, its benefit is diminished since buried seeds will be brought back to the surface where these can germinate. A rotational tillage may be a better strategy in those scenarios.

Rotary hoeing and inter-row cultivation remain viable practices in today's production systems. Rotary hoeing is beneficial when preemergence herbicides are not activated by rainfall. Rotary hoeing needs to be conducted prior to weed emergence (white-root stage) for greatest effectiveness. Due to waterhemp's prolonged emergence pattern, the rotary hoe will not make significant contributions to full-season waterhemp control. However, using a rotary hoe to eliminate the first flush of early-emerging weeds can allow the postemergence application to be delayed, which improves waterhemp management. This strategy also will reduce selection pressure on postemergence herbicides from a resistance management standpoint.

Cultivation remains a highly effective tool to control weeds in crops planted in wide-row spacings. Because of increases in farm size, it is unrealistic to expect cultivation to be used as it was in the past. However, many growers could use cultivation on problem fields or areas within fields where weeds have escaped the chemical control program. As with other field operations, auto-steer has eliminated much of the drudgery of this practice, allows faster operating speeds, and reduces the potential for crop injury.

## Narrow-row spacing

Crop competitiveness is an important factor in determining the outcomes of crop-weed interference and can be improved by reducing the row spacing. Narrow-row soybean planting first was practiced in the northern part of the soybean belt to allow soybean to capture more sunlight and get ahead of weeds. Planting soybean in reduced row spacing (15 inches) helps the crop to achieve canopy closure quicker. Faster canopy closure ensures more light interception through the growing season, which often ends in an improved crop yield and a greater shading of weeds.

Despite these benefits, planting soybean in 30-inch rows is a predominant practice in Iowa. Based on the 2021 Iowa Agricultural Statistics Services Survey, about 52% of Iowa growers planted soybean in 30-inch rows

compared to only 42% growers planting in 12-inch wide rows in the last five years.

Weed management always has been considered while planning for optimum row spacing in soybean. Before advances in herbicide development, soybean had been planted in 30-inch rows to allow for a mid- to late-season inter-row cultivation. However, this practice has been used even after advances in herbicide technology and reduction in tillage. This is due primarily to the increased cost of herbicide-tolerant crop seeds. Lack of willingness to invest in an additional planter for narrow-row soybean also hindered the adoption of this practice. Furthermore, lower disease infestation in a wide vs. narrow-row soybean made wide-row soybean even more economical for growers. For example, the thick and dense canopy in narrow-row soybean can create cool and moist conditions under the canopy and lead to a white mold infestation. However, white mold in narrow-row soybean can be managed effectively by using fungicides, resistant varieties, and crop rotation. Due to widespread occurrence of herbicide-resistant (HR) weed populations and lack of effective herbicides, there is an urgent need to utilize agronomic practices that favor the crops over the weeds.

Row width, plant population, and environmental conditions are the key factors in the development of soybean canopy. Narrow rows make soybean more competitive against the weeds by reducing the quantity and quality of light required for weed seed germination and growth. Based on Iowa State University research conducted in Iowa, soybean growing in 15-inch rows achieves canopy closure approximately two weeks earlier than soybean growing in 30-inch rows.

Quicker and dense canopy closure of soybean enhances the weed control efficacy of other control tactics by reducing weed density and biomass (size of weeds). For example, previous research found an increase in herbicide efficacy when controlling waterhemp in narrow- vs. wide-row soybean. Similarly, in a recent study conducted at Iowa State, the cereal rye cover crop provided a greater suppression of waterhemp when soybean was planted in 15-inch vs. 30-inch wide rows. This complimentary strategy is important in the current era of herbicide resistance. Eeduced weed density and size of weeds will reduce the burden on postemergence herbicides; hence, a reduced selection pressure for the development of herbicide resistance.

In conclusion, planting soybean in narrow-rows (15-inches wide) would be an important consideration while planning for weed management with herbicide shortages.

## Cover crops

Cover crops have been beneficial in preventing soil erosion by providing surface residue, trapping residual nitrate that otherwise will be leached out in drainage, improving soil organic matter and other physical properties, and suppressing weeds. Cereal rye is the most widely used cover crop in the Midwestern US due to its winter hardiness, ease to grow, and high biomass accumulation. A cereal rye cover crop suppresses weeds primarily by physically impeding emergence and growth, and to a certain extent, by inhibiting weed seed germination by releasing allelochemicals. The amount of biomass accumulation by a cereal rye cover crop has a direct influence on its ability to suppress weed emergence and growth, as well as on the duration of weed suppression. The level of suppression is influenced by weed species being targeted, timing of cover crop termination, and timing of weed emergence.

The goal of a higher biomass accumulation by cereal rye in soybean can be achieved by planting it early in the fall and/or delaying the termination timing in the spring. Although a delay in the cereal rye termination significantly increases the level of weed suppression, the timing of termination should be synchronized with the emergence period of the target weed species in the field.

Based on recent studies conducted at Iowa State, a cereal rye cover crop is effective in suppressing marestail (horseweed) due to the timing of its emergence. A fall-planted cereal rye cover crop suppresses density and biomass (size) of both fall- and spring-emerging marestail. The cereal rye cover crop terminated (with glyphosate) one week before soybean planting reduced marestail density by 90% and biomass by only 55% compared with a no cover crop treatment. However, delayed termination (7 to 10 days after soybean planting) reduced both the density and biomass of marestail plants by 90%. Similarly, the late-terminated cover crop reduced waterhemp density by 70%, whereas the early-termination timing reduced waterhemp density by only 55%, compared with the no cover crop plots. Since waterhemp emerges relatively late in the season, terminating the cereal rye cover crop at or after soybean planting (planting green) is desirable to prolong the length of weed suppression.

Significant delays in termination timing of the cereal rye cover crop may affect soybean growth and grain yields at harvest. However, in Iowa State University, studies conducted in central Iowa 2019-2021, soybean yields were not affected when cereal rye was terminated at 7 to 10 days after soybean planting (planting green), when compared to early termination timing or no cover crop treatment. Another concern with delayed termination of cover crop is that the

resulting high biomass can physically tie-up the soil residual herbicides, thereby reducing their availability in the soil where preemergence herbicides are active. However, in our studies, we did not observe a reduced efficacy of soil residual herbicides (S-metolachlor and fomesafen, Prefix) for waterhemp control between early and late termination timings of the cereal rye cover crop.

In conclusion, a cereal rye cover crop should be adopted as an effective cultural strategy to manage herbicide-resistant weed populations and enhance the efficacy of other weed control tactics in soybean. Additionally, Iowa Department of Agriculture and Land Stewardship and USDA offer premium benefits ($5-per-acre, from each agency) to Iowa growers when they plant cover crops on their farm fields.

## Harvest weed seed control

WhileLate-season weed escapes/ survivors are common in corn and soybean production fields in Iowa. Although late-emerged/escaped seedlings may not affect crop yields, these still can produce significant amounts of seeds, thereby causing future weed infestations. During a conventional harvest operation, weed seeds also are harvested with the crop, separated from the grain along with the crop chaff, and spread back to the field. Therefore, methods that limit the spread of weed seeds are crucial, especially for herbicide-resistant weeds like waterhemp that are prolific seed producers. More recently, several harvest weed seed control methods (HWSC) have been developed to collect and mange/destroy weed seeds at the time of crop harvest. The most common HWSC methods are weed seed destructors and chaff liners (concentrating weed seeds in a narrow band at harvest). The Iowa State University Weed Science program is testing both methods to combat herbicide-resistant waterhemp in Iowa with a high success rate.

The weed seed destructor is an additional unit that can be integrated with a commercial combine to separate soybean chaff plus weed seeds from the straw and divert those to high-impact cage mills at the rear of the combine. In Iowa State research conducted in 2020 and 2021, a Redekop weed seed destructor equipped with a John Deere S680 combine destroyed about 90% of waterhemp seeds remaining on the mother plant at the time of soybean harvest.

Chaff lining involves making a simple chute to divert the weed seed-bearing chaff fraction (from the sieves) into a narrow windrow (12 to 18 inches wide), which is left to rot or mulch while the straw is chopped and spread. Thus, chaff lining concentrates weed seeds to <5% of the field, rather than spreading these across the entire field as happens with conventional harvest. The concentration of the chaff material places weed seeds in an environment suitable for predation, microbial decay, or unsuitable for germination and emergence, if left undisturbed. Potentially, the chaff can act as a mulch to suppress emergence of small-seeded weeds such as waterhemp. Emerged weed seedlings in the chaff lines can be targeted with additional weed control tactics in the subsequent growing season.

In Iowa State studies, a chaff-liner equipped with a John Deere S660 combine concentrated greater than 95% of the waterhemp seeds that entered the combine into the chaff line. In the following season in corn, waterhemp plants growing inside the chaff line accumulated 60% less biomass than plants growing outside the chaff line. This tactic was complimentary in enhancing the efficacy of herbicide programs for waterhemp control and can potentially reduce herbicide use and cost over time.

In conclusion, these novel HWSC technologies hold great promise in the Midwestern corn-soybean production systems; and should be integrated with current weed control practices to target weed seeds at harvest, and reduce selection pressure exerted by herbicides, thereby managing herbicide-resistant weed seed banks.

## Summary

Weeds are the universal pest; every field has an economic level of weed infestation every year. The current system of large farms and narrow profit margins limits flexibility in the types of tactics and investments that can be made for weed management. This also makes it difficult to factor in long-term weed management considerations such as herbicide resistance. However, the increasing rate of herbicide resistance in Iowa is a serious threat to future productivity. Taking the time to critically examine herbicide programs to insure multiple sites of action are controlling target weeds is the first step in developing resilient weed management systems. However, herbicides alone cannot prevent the rapid adaptation of weeds to these crop protection tools. The production system of individual farms needs to be evaluated to determine alternative weed control tactics that are appropriate for the operation.

Acknowledgement: A portion of this article was adapted from material in the 2014 Ohio and Indiana Weed Control Guide, Ohio State University Extension and Purdue Extension.

# Planning for Herbicide Shortages

Glyphosate and glufosinate are the two most widely used herbicides in the U.S. Shortage of these two herbicides in 2022 has put a strain on grower ability to achieve weed management goals in corn and soybean. Therefore, this growing season may be different from any normal year for many growers.

Below are the alternatives to cope with glyphosate and glufosinate shortages and achieve weed management goals in corn and soybean.

## Burndown Herbicide Programs

One of the best alternative herbicide programs to control both grasses and broadleaves before corn and soybean planting is paraquat + 2,4-D + metribuzin. Paraquat performs better when a triazine herbicide is added. Adding 2,4-D to paraquat and metribuzin would serve as a broad-spectrum burndown and residual herbicide program. When grass weeds are not a concern, saflufenacil + 2,4-D + metribuzin can be used to achieve good foliar and residual control of broadleaf weeds.

## Cover Crop Termination

Glyphosate is the most effective herbicide to terminate a cereal rye cover crop. For those who have a fall planted cereal rye cover crop and a limited supply of glyphosate, the Iowa State recommendation is to use that glyphosate for cover crop termination. The next alternative is paraquat (Gramoxone), with a high carrier volume to optimize spray coverage. Tank-mixing a triazine herbicide such as metribuzin improves the efficacy of paraquat in killing cereal rye prior to planting soybean. In addition, metribuzin will provide residual control of late-emerging weeds like waterhemp.

Roller crimping is a non-chemical option to terminate a cereal rye cover crop. Roller crimping is most effective when used at the early milk to soft dough stage of cereal rye. It takes longer for cereal rye to die when terminated with a roller-crimper vs. herbicides such as glyphosate. However, roller crimping can be beneficial as it keeps the ground covered for a longer period of time; hence, an extended duration of weed suppression.

If none of the options mentioned above are available, mowing can be an alternative method for cover crop termination. A sickle bar, rotary, and flail mower can be used to mow the cover crop prior to or at soybean planting. To avoid regrowth, cereal rye should be mowed at or after the flowering growth stage. Additionally, HG 1 herbicides (Clethodim, Quizalofop) can be used to prevent further regrowth of cereal rye in soybean.

## Soybean Herbicide Programs

A majority of the preemergence herbicide programs in soybean are based on HG 5 (metribuzin) and HG 14 (flumioxazin, sulfentrazone). Products such as Fierce EZ, Moccasin MTZ, Tripzin ZC, or Authority Elite contains herbicide active ingredients from two sites of action. Fierce MTZ, Zidua Pro, or Panther Pro contains herbicides from three sites of action. All of these products provide effective foliar and residual activity when applied preemergence, especially for late-emerging waterhemp.

Since dicamba (Xtendimax, Engenia, Tavium) or 2,4-D choline (Enlist One, Enlist Duo) will be carrying more burden for postemergence herbicide programs this year, selecting an appropriate herbicide-tolerant soybean trait will be critical. Apart from dicamba and 2,4-D, products containing herbicides from HG 14 (lactofen, fomesafen etc.) can be used to achieve broadleaf weed control. Similarly, HG 1 herbicides (Select/Select Max, Assure II etc.) can be used to control grass weeds as an alternative to glyphosate. However, activity of HG 1 herbicides on grass weeds (including volunteer corn) can be antagonized when tank-mixed with dicamba (Xtend/Xtendflex soybean), 2,4-D (Enlist E3 soybean), or acetochlor.

In conclusion, a strong preemergence herbicide program with multiple HGs (5, 14, 15) and a timely layered postemergence residual (HG 15) will serve as the foundation for effective waterhemp control in soybean.

# Corn Herbicide Effectiveness Ratings[1]

| | | | Grasses | | | | | Broadleaves | | | | | | | | | Perennials | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Weed response to selected herbicides**<br>E = excellent<br>G = good<br>F = fair<br>P = poor | **Herbicide Group Number** | **Crop tolerance** | **Crabgrass** | **Fall panicum** | **Foxtail** | **Woolly cupgrass** | **Shattercane[2]** | **Waterhemp[2, 4, 5, 6, 7, 8]** | **Black nightshade** | **Cocklebur[2]** | **Common ragweed** | **Giant ragweed[2, 4, 8]** | **Lambsquarter** | **Smartweed** | **Sunflower[2]** | **Velvetleaf** | **Canada thistle** | **Quackgrass** | **Yellow nutsedge** |
| **Preplant/Preemergence** | | | | | | | | | | | | | | | | | | | |
| Atrazine | 5 | 5 | F | P | F | P | P | E | G | G | E | F-G | E | E | G | G | P | F | F |
| Balance Flexx (isoxaflutole) | 27 | E | G | F-G | G | G-E | F-G | G-E | F | P-F | F-G | P | G | G-E | F | G-E | P | P | G |
| Breakfree, Harness, Surpass NXT, etc. (acetochlor) | 15 | E | E | E | E | F-G | F-G | G | G | P | P | P | P-F | P-F | P | P | P | P | G |
| Callisto (mesotrione) | 27 | E | P | P | P | P | P | G-E | G-E | F-G | F-G | F | E | F-G | G-E | E | P | P | P |
| Cinch, Dual II Magnum, Outlook, Zidua etc. | 15 | E | E | E | E | F | F | F-G | G | P | P | P | P | P | P | P | P | P | G |
| Hornet WDG (flumetsulam, clopyralid) | 2, 4 | G | P | P | P | P | P | G-E | F-G | G | G | G | G | G-E | G-E | G | P | P | P |
| Linex, Lorox (linuron) | 7 | G | P-F | P-F | P | P | P | G-E | F | F | G | P-F | G-E | G-E | F | F | P | P | P |
| Pendimax, Prowl, etc. (pendimethalin) | 3 | F-G | G-E | G-E | G-E | G | G | G | P | P | P | P | G-E | F | P | P-F | P | P | P |
| Python (flumetsulam) | 2 | G | P | P | P | P | P | E | F-G | F | G | F | F-G | G-E | F-G | G-E | P | P | P |
| Sharpen (saflufenacil) | 14 | G | P | P | P | P | P | G-E | G-E | G | G | G | G-E | G | G-E | G-E | P | P | G |
| | | | | | | | | | | | | | | | | | | | |
| **Postemergence** | | | | | | | | | | | | | | | | | | | |
| Accent Q, Steadfast Q (nicosulfuron, rimsulfuron) | 2 | G-E | P | G | G-E | G-E | E | G | P | F | P | P | P | G | P | F | F | G | F |
| Aim (carfentrazone) | 14 | G | P | P | P | P | P | F-G | G | P | P | F | G | P | P | E | P | P | P |
| Armezon, Impact (topramezone) | 27 | G-E | F-G | F | G | F | F | G-E | G-E | G-E | G | G | G | G | E | E | P | P | P |
| Atrazine | 5 | G | F | P | F | P | P | E | E | E | E | G | E | E | E | E | F* | F | G |
| Basagran (bentazon) | 6 | E | P | P | P | P | P | P | P | E | E | F | P | E | G | G-E | G* | P | G* |
| Basis, Basis Blend (rimsulfuron, thifensulfuron) | 2 | F | F | F-G | G | F | G | G | P | F | F | P | G-E | G-E | G-E | G | P | G | P |
| Banvel, Clarity, DiFlexx, Xtendimax with Vapor Grip Technology Engenia, FeXapan, etc (dicamba) | 4 | F-G | P | P | P | P | P | G-E | G | E | G-E | E | G | E | G | F-G | G* | P | P |
| Beacon (primisulfuron) | 2 | G | P | F-G | P-F | P | E | E | G | G | G | E | P | G | G | F-G | F-G* | G | F |
| Buctril (bromoxynil) | 6 | G | P | P | P | P | P | G | G-E | E | E | G | G-E | G-E | E | G | P | P | P |
| Callisto (mesotrione) | 27 | G-E | P | P | P | P | P | E | E | G-E | F | G | G | E | G-E | E | P | P | P |
| Enlist One (2, 4-D)[3] | 4 | E | P | P | P | P | P | G-E | G | E | E | E | E | F-G | G-E | G-E | F-G | P | P |
| Hornet WDG (flumetsulam, clopyralid) | 9 | E | E | E | G-E | E | E | G-E | F-G | E | E | G-E | G | E | E | G | G | G-E | F |
| Liberty (glufosinate)[3] | 2, 4 | G | P | P | P | P | P | G-E | F | E | E | G-E | F | G-E | E | G-E | G | P | P |
| Laudis (tembotrione) | 10 | E | E | G | G-E | E | E | G | E | E | E | G | G | E | E | E | F-G | G | P |
| Permit, Halomax, etc. (halosufuron) | 27 | G-E | F-G | F | G-E | F-G | F-G | E | G-E | G-E | G | G | G | G | E | E | P | P | P |
| Resolve (rimsulfuron) | 2 | G | P | P | P | P | P | E | P | G-E | G-E | G | P | G-E | E | E | P | P | G |
| Resource (flumiclorac) | 2 | F | F | F-G | G | F | G | G | P | F | F | P | G-E | G | P | F-G | F | G | F |
| Roundup (glyphosate)[3] | 14 | G-E | P | P | P | P | P | G | P | F | F-G | P | F | P | P | E | P | P | P |
| Shieldex (topyrlate) | 27 | G-E | F-G | P | G | P | G | E | E | F-G | G | G | G | F-G | E | E | P | P | P |
| Status (dicamba, diflufenzopyr) | 4, 19 | F-G | P | F | F | P | F | G-E | G | E | G-E | G | G | E | G | G | G* | P | P |

[1]Ratings are based on full label rates. **Premix products containing ingredients marketed as single a.i. products may not be listed in this table.**

[2]ALS-resistant biotypes of these weeds have been identified in Iowa. These biotypes may not be controlled by all ALS herbicides.

[3]Use only on designated resistant hybrids.

[4]Glyphosate-resistant biotypes of these weeds have been identified in Iowa. These biotypes may not be controlled by glyphosate.

[5]PPO-resistant biotypes of waterhemp have been identified in Iowa. These biotypes may not be controlled by PPO inhibitor herbicides.

[6]HPPD-resistant biotypes of waterhemp have been identified in Iowa. These biotypes may not be controlled by HPPD herbicides.

[7]PSII-resistant biotypes of waterhemp have been identificed in Iowa. These biotypes may not be controlled by PSII herbicides.

[8]Biotypes of this weed with resistance to multiple sites of herbicide action have been identified in Iowa.

*Degree of perennial weed control is often a result of repeated application.

This chart should be used only as a guide. Ratings of herbicides may be higher or lower than indicated depending on soil characteristics, managerial factors, environmental variables, and rates applied. The evaluations for herbicides applied to the soil reflect appropriate mechanical weed control practices.

# Soybean Herbicide Effectiveness Ratings[1]

| Weed response to selected herbicides<br>E = excellent<br>G = good<br>F = fair<br>P = poor | Herbicide Group Number | Crop tolerance | Grasses | | | | | Broadleaves | | | | | | | | | Perennials | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Crabgrass | Fall panicum | Foxtail | Woolly cupgrass | Shattercane[2] | Waterhemp[2,4,5,6,7,8] | Black nightshade | Cocklebur[2] | Common ragweed | Giant ragweed[2,4,8] | Lambsquarter | Smartweed | Sunflower[2] | Velvetleaf | Canada thistle | Quackgrass | Yellow nutsedge |
| **Preplant/Preemergence** | | | | | | | | | | | | | | | | | | | |
| Authority, Spartan (sulfentrazone) | 14 | G | P-F | P | P-F | P | P | E | E | F | F | F | G-E | F | P | F-G | P | P | F-G |
| Dual II Magnum, Warrant, Zidua (*S*-metolachlor, acetochlor, pyroxasulfone) | 15 | E | E | E | E | F | F | F-G | G | P | P | P | P | P | P | P | P | P | P |
| Command (clomazone) | 13 | E | G-E | G-E | E | F | F | P | F | F | G | P | G-E | G | F | E | P | P | P |
| Engenia, FeXapan, Xtendimax w/ VGT (dicamba)[3] | 4 | E | P | P | P | P | P | F | G | G | G | G-E | G | G | G | F-G | G* | P | P |
| FirstRate, Amplify (cloransulam) | 2 | G-E | P | P | P | P | P | F-G | P | G | G-E | G-E | G | G-E | G | F-G | P | P | F-G |
| Linex, Lorox (linuron) | 7 | F | P-F | P-F | P | P | P | G-E | F | F | G | P-F | G-E | G-E | F | F | P | P | P |
| Prowl, Treflan, etc. (pendimethalin, trifluralin) | 3 | G-E | E | E | E | E | G-E | G | P | P | P | P | G | F | P | P | P | P | P |
| Pursuit (imazethapyr) | 2 | G | F-G | F | F-G | P-F | G | F-E | G-E | F | G | F | G | G-E | F-G | G | P | P | P |
| Python (flumetsulam) | 2 | E | P | P | P | P | P | E | F | F | F | P | F-G | G-E | F | E | P | P | P |
| Metribuzin, Sencor, TriCor, etc. | 5 | F-G | P | P | P-F | P | P | E | F | F | E | P | E | E | F-G | G-E | P | P | P-F |
| Sharpen (saflufenacil) | 14 | G | P | P | P | P | P | F | F | F | F | F | F | F | F | F | P | P | P |
| Valor SX, Rowel (flumioxazin) | 14 | F-G | P | P | P | P | P | G-E | E | P | G | F | G-E | F | P | F | P | P | P |
| | | | | | | | | | | | | | | | | | | | |
| **Postemergence** | | | | | | | | | | | | | | | | | | | |
| Assure II, Fusilade DX, Fusion, Poast Plus, Select, (quizalofop, fluazifop, sethoxydim, clethodim) | 1 | E | E | E | E | E | E | P | P | P | P | P | P | P | P | P | P | G-E* | P |
| Basagran (bentazon) | 6 | E | P | P | P | P | P | P-F | P-F | E | E | F | P | E | G | G-E | G* | P | G* |
| Blazer (acifluorfen) | 14 | F-G | P | P | F | P | F | E | G | F | G | F | F | E | F | F | F | P | P |
| Classic (clorimuron) | 2 | G | P | P | P | P | P | E | P | E | G-E | F | P | G-E | E | G-E | F | P | G-E |
| Cobra, Phoenix (lactofen) | 14 | F-G | F | P | P | P | P | E | G | G-E | E | F-G | F | G | G | F | F | P | P |
| Engenia, FeXapan, Xtendimax with VGT (dicamba)[3] | 4 | E | P | P | P | P | P | G-E | G | E | G-E | E | G | E | G | F-G | G* | P | P |
| Enlist One (2,4-D)[3] | 4 | E | P | P | P | P | P | G-E | G | E | E | E | E | F-G | G-E | G-E | F-G* | P | P |
| FirstRate, Amplify (cloransulam) | 2 | G | P | P | P | P | P | P | P | G-E | E | E | P | G | E | G | P | P | P |
| Harmony (thifensulfuron) | 9 | E | E | G-E | E | E | E | G-E | F-G | E | E | G-E | G | E | E | G | G | G-E | F |
| Liberty (glufosinate)[3] | 2 | F | P | P | P | P | P | E | P | F | F | P | G-E | G-E | G-E | G | P | P | P |
| Pursuit (imazethapyr) | 10 | E | E | G | G-E | E | E | G | E | E | E | G | G | E | E | E | F-G | G | F |
| Raptor (imazamox) | 2 | G | G | G | F-G | F | E | F-G | E | G-E | G | F | P-F | E | G | G-E | F | P | P |
| Reflex, Flexstar (fomesafen) | 2 | G | G-E | G-E | G-E | G | E | F-G | E | G-E | G | G | G | E | E | G-E | F | F | F |
| Resource (flumiclorac) | 14 | F-G | P | P | P | P | P | E | F-G | F | G | G | F | G-E | F | F | P-F | P | P |
| Roundup (glyphosate)[3] | 14 | G-E | P | P | P | P | P | G | P | F | F-G | P | F | P | P | E | P | P | P |

[1]Ratings in this table are based on full label rates. **Premix products containing ingredients marketed as single a. i. products may not be included in this table.**

[2]ALS-resistant biotypes have been identified in Iowa. These biotypes may not be controlled by all ALS products.

[3]Use only on appropriate resistant varieties.

[4]Glyphosate-resistant biotypes of these weeds have been identified in Iowa. These biotypes may not be controlled by glyphosate.

[5]PPO-resistant biotypes of common waterhemp have been identified in Iowa. These biotypes may not be controlled by PPO inhibitor herbicides.

[6]HPPD-resistant biotypes of common waterhemp have been identified in Iowa. These biotypes may not be controlled by HPPD herbicides.

[7]PSII-resistant biotypes of these weeds have been identifed in Iowa. These biotypes may not be controlled by PSII inhibitor herbicides.

[8]Biotypes of this weed with resistance to multiple sites of herbicide action have been identified in Iowa.

*Degree of perennial weed control is often a result of repeated application.

This chart should be used only as a guide. Ratings of herbicides may be higher or lower than indicated depending on soil characteristics, managerial factors, environmental variables, and rates applied. The evaluations for herbicides applied to the soil reflect appropriate mechanical weed control practices.

# Grazing and Haying Restrictions for Herbicides Used in Grass Pastures

| | | | | Beef and Non-Lactating Animals | | | Lactating Dairy Animals | |
|---|---|---|---|---|---|---|---|---|
| **Herbicide** | **A. I.** | **HG** | **Rate/A** | **Grazing** | **Hay harvest** | **Removal before slaughter** | **Grazing** | **Hay harvest** |
| 2,4-D | 2,4-D | 4 | 1.5 to 2.0 lb ae | | 7 days | 0 | 0 | 7 days |
| Clarity and many others | dicamba | 4 | Up to 1 pt | 0 | 0 | 30 days | 7 days | 37 days |
| | | | 1-2 pt | 0 | 0 | 30 days | 21 days | 51 days |
| | | | 2-4 pt | 0 | 0 | 30 days | 40 days | 70 days |
| | | | 4-16 pt | 0 | 0 | 30 days | 60 days | 90 days |
| Chaparral | aminopyralid + metsulfuron methyl | 4, 2 | 1-3.3 oz | 0 | 0 | 0 | 0 | 0 |
| Cimarron Max (co-pack) | metsulfuron methyl + dicamba + 2,4-D | 2, 4, 4 | 0.25-1 oz A + 1-4 pt B | 0 | 0 | 30 days | 7 days | 37 days |
| Cimarron X-Tra | metsulfuron methyl + chlorsulfuron | 2, 2 | 0.1-1.0 oz | 0 | 0 | 0 | 0 | 0 |
| Crossbow | triclopyr + 2,4-D | 4, 4 | 1-6 qt | 0 | 14 days | 3 days | Growing season | Growing season |
| Curtail | clopyralid + 2,4-D | 4, 4 | 2-4 qt | 0 | 7 days | 7 days* | 14 days | 7 days |
| Duracor | aminopyralid + florpyrauxifen-benzyl | 4, 4 | 12-20 oz | 0 | 14 days | 0 | 0 | 14 days |
| Escort XP | metsulfuron methyl | 2, 2 | Up to 1.7 oz | 0 | 0 | 0 | 0 | 0 |
| ForeFront HL | aminopyralid + 2,4-D | 4, 4 | 1.2-2.1 pt | 0 | 7 days | 0 | 0 | 7 days |
| Grazon P&D | picloram + 2,4-D | 4, 4 | 3-4 pt | 0 | 30 days | 3 days | 7 days | 30 days |
| Milestone | aminopyralid | 4 | 3-7 oz | 0 | 0 | 0 | 0 | 0 |
| Overdrive | dicamba + diflufenzopyr | 4, 19 | 4-8 oz | 0 | 0 | 0 | 0 | 0 |
| PastureGard HL | triclopyr + fluroxypyr | 4, 4 | 1-1.5 pt | 0 | 14 days | 3 days | 1 year | 1 year |
| Rave | dicamba + triasulfuron | 4, 2 | 2-5 oz | 0 | 37 days | 30 days | 7 days | 37 days |
| Redeem R&P | triclopyr + clopyralid | 4, 4 | 1.5-4 pt | 0 | 14 days | 3 days | Growing season | Growing season |
| Remedy Ultra | triclopyr | 4, 19 | 1-2 qt | 0 | 14 days | 3 days | Growing season | Growing season |
| Surmount | picloram + fluroxypyr | 4, 4 | 1.5-6 pts | 0 | 7 | 3 | 14 | 7 |
| Tordon 22K | picloram | 4 | < 2 pts | 0 | 0 | 3 | 14 | 14 |
| | | | > 2 pts | 0 | 14 | 3 | 14 | 14 |
| Weedmaster | dicamba + 2,4-D | 4, 4 | 1-4 pts | 0 | 7 days | 30 days | 7 days | 7 days |

*7 days slaughter interval if Curtail was freshly applied, withdrawal not needed if 2 weeks or more have elapsed since application.

# Herbicide Package Mixes

The following table provides information concerning the active ingredients found in prepackage mixes, the amount of active ingredients applied with a typical use rate, and the equivalent rates of the individual products.

## Corn Herbicide Premixes or Co-packs and Equivalents

| Herbicide | Group | Components (a. i /gal or % a. i.) | If you apply (per acre) | You have applied a.i. | An equivalent tank mix of (product) |
|---|---|---|---|---|---|
| Acuron | 15 | 2.14 lb S-metolachlor | 3 qt | 1.6 lb S-metolachlor | 27 oz Dual II Magnum |
| | 5 | 1.0 lb atrazine | | 0.75 lb atrazine | 1.5 pt atrazine 4L |
| | 27 | 0.24 lb mesotrione | | 0.18 lb mesotrione | 5.8 oz Callisto |
| | 27 | 0.06 lb bicyclopyrone | | 0.72 oz bicyclopyrone | N/A |
| Acuron Flexi | 27 | 0.08 lb bycylopyrone | 2.25 qt | 0.72 oz bicyclopyrone | N/A |
| | 27 | 0.32 lb mesotrione | | 0.18 lb mesotrione | 5.8 oz Callisto |
| | 15 | 2.86 lb S-metolachlor | | 1.61 lb S-metolachlor | 27 oz Dual II Magnum |
| Acuron GT | 15 | 2.00 lb S-metolachlor | 3.75 pt | 0.94 lb S-metolachlor | 15.75 oz Dual II Magnum |
| | 9 | 2.00 lb ae glyphosate | | 0.94 lb ae glyphosate | 1.67 pt Roundup WMax |
| | 27 | 0.20 lb mesotrione | | 1.5 oz mesotrione | 3 oz Callisto |
| | 27 | 0.095 lb bicyclopyrone | | 0.7 oz bicyclopyrone | N/A |
| Alluvex WSG | 2 | 16.7% rimsulfuron | 1.5 oz | 0.25 oz rimsulfuron | 0.5 oz Harmony SG |
| | 2 | 16.7% thifensulfuron | | 0.25 oz thifensulfuron | 1.0 oz Resolve SG |
| Anthem | 15 | 2.087 lb pyroxaslufone | 10 oz | 0.16 lb pyroxasulfone | 3.0 oz Zidua |
| | 14 | 0.063 lb fluthiacet-methyl | | 0.08 oz fluthiacet-methyl | 0.7 oz Cadet |
| Anthem Maxx | 15 | 4.174 lb pyroxasulfone | 5 oz | 0.16 oz pyroxasulfone | 3.0 oz Zidua |
| | 14 | 0.126 lb fluthiacet-methyl | | 0.08 oz fluthiacet-methyl | 0.7 oz Cadet |
| Anthem ATZ | 5 | 4 lb atrazine | 2 pt | 1 lb atrazine | 2 pt atrazine 4L |
| | 15 | 0.485 lb pyroxasulfone | | 0.12 lb pyroxasulfone | 2.25 oz Zidua |
| | 14 | 0.014 lb fluthiacet | | 0.06 oz fluthiacet-methyl | 0.6 oz Cadet |
| Armezon Pro | 15 | 5.25 lb dimethenamid-P | 20 oz | 0.82 lb dimethenamid-P | 17.5 oz Outlook |
| | 27 | 0.1 lb topramezone | | 0.26 oz topramezone | 0.73 oz Armezon |
| Basis Blend | 2 | 20% rimsulfuron | 0.825 oz | 0.167 oz rimsulfuron | 0.67 Resolve |
| | 2 | 10% thifensulfuron | | 0.083 oz thifensulfuron | 0.16 oz Harmony |
| Bicep II MAGNUM, Cinch ATZ, Medal II AT, Charger Max ATZ | 15 | 2.4 lb S-metolachlor | 2.1 qt | 1.26 lb S-metolachlor | 1.31 pt Dual II MAGNUM |
| | 5 | 3.1 lb atrazine | | 1.63 lb atrazine | 3.25 pt Aatrex 4L |
| Bicep Lite II MAGNUM, Cinch ATZ Lite, Charger Max ATZ Lite | 15 | 3.33 lb S-metolachlor | 1.5 qt | 1.25 lb S-metolachlor | 1.31 pt Dual II MAGNUM |
| | 5 | 2.67 lb atrazine | | 1.00 lb atrazine | 2 pt atrazine 4L |
| Breakfree NXT ATZ | 15 | 3.1 lb acetochlor | 2.7 qt | 2.1 lb acetochlor | 2.4 pt Breakfree NXT |
| | 5 | 2.5 lb atrazine | | 1.7 lb atrazine | 3.4 pt atrazine 4L |

## Corn Herbicide Package Mixes (continued)

| Herbicide | Group | Components (a. i /gal or % a. i.) | If you apply (per acre) | You have applied a.i. | An equivalent tank mix of (product) |
|---|---|---|---|---|---|
| Breakfree NXT Lite | 15 | 4.3 lb acetochlor | 2 qt | 2.2 lb acetochlor | 2.5 pt Breakfree NXT |
| | 5 | 1.7 lb atrazine | | 0.85 lb atrazine | 1.7 pt atrazine 4L |
| Callisto GT | 9 | 3.8 lb glyphosate | 2 pt | 0.95 lb glyphosate | 1.8 pt Touchdown |
| | 27 | 0.38 lb mesotrione | | 1.52 oz mesotrione | 3.04 oz Callisto |
| Callisto Xtra | 27 | 0.5 lb mesotrione | 24 fl oz | 1.44 oz mesotrione | 3.0 oz Callisto |
| | 5 | 3.2 lb atrazine | | 0.6 lb atrazine | 1.2 pt atrazine 4L |
| Capreno | 2 | 0.57 lb thiencarbazone | 3.0 oz | 0.16 oz thiencarbazone | - |
| | 27 | 2.88 lb tembotrione | | 1.09 oz tembotrione | 2.5 oz Laudis |
| Corvus | 27 | 1.88 lb isoxaflutole | 5.6 oz | 1.3 oz isoxaflutole | 5.1 oz Balance Flexx |
| | 2 | 0.75 lb thiencarbazone | | 0.5 oz thiencarbazone | |
| Crusher 50 WDF | 2 | 25% rimsulfuron | 1 oz | 0.25 oz rimsulfuron | 1 oz Resolve SG |
| | 2 | 25% thifensulfuron | | 0.25 oz thifensulfuron | 0.5 oz Harmony SG |
| Degree Xtra | 15 | 2.7 lb acetochlor | 3 qt | 2 lb acetochlor | 2.29 pt Harness 7E |
| | 5 | 1.34 lb atrazine | | 1 lb atrazine | 1 qt atrazine 4L |
| DiFlexx Duo | 27 | 0.27 lb tembotrione | 32 oz | 0.067 lb tembotrione | 2.5 oz Laudis |
| | 4 | 1.86 lb dicamba | | 0.31 lb dicamba | 10 oz DiFlexx |
| Distinct 70WDG | 19 | 21.4% diflufenzopyr | 6 oz | 1.3 oz diflufenzopyr | 1.3 oz diflufenzopyr |
| | 4 | 55.0% dicamba | | 3.3 oz dicamba | 6 oz Banvel |
| Enlist Duo | 4 | 1.6 lb 2,4-D choline salt | 4.75 pt | 0.95 lb ae 2,4-D | 1.9 pt 2,4-D 4A |
| | 9 | 1.7 lb glyphosate DMA | | 1.0 lb ae glyphosate | 2 pt Durango DMA |
| Expert 4.9SC | 15 | 1.74 lb S-metolachlor | 3 qt | 1.3 lb S-metolachlor | 1.4 pt Dual II Mag. |
| | 5 | 2.14 lb atrazine | | 1.61 lb atrazine | 1.6 qt Aatrex 4L |
| | 9 | 0.74 lb ae glyphosate | | 0.55 lb ae glyphosate | 1.5 pt Glyphosate 3L |
| Fierce | 14 | 33.5% flumioxazin | 3 oz | 1 oz flumioxazin | 2 oz Valor |
| | 15 | 42.5% pyroxasulfone | | 1.28 oz pyroxasulfone | 1.5 oz Zidua |
| FulTime NXT | 15 | 2.7 lb acetochlor | 3 qt | 2.0 lb acetochlor | 2.5 pt Surpass 6.4EC |
| | 5 | 1.34 lb atrazine | | 1.0 lb atrazine | 2.0 pt atrazine 4L |
| Halex GT | 15 | 2.09 lb S-metolachlor | 3.6 pt | 0.94 lb S-metolachlor | 1.0 pt Dual II Magnum |
| | 27 | 0.209 lb mesotrione | | 1.44 oz mesotrione | 3.0 oz Callisto |
| | 9 | 2.09 lb glyphosate | | 0.94 lb glyphosate ae | 1.5 pt Touchdown HiTech |
| Harness MAX | 15 | 3.52 lb acetochlor | 75 fl oz | 2.05 lb acetochlor | 2.3 pt Harness |
| | 27 | 0.33 lb mesotrione | | 0.188 lb mesotrione | 6.0 oz Callisto |
| Harness Xtra, Confidence Xtra | 15 | 4.3 lb acetochlor | 2.3 qt | 2.5 lb acetochlor | 2.9 pt Harness 7E |

## Corn Herbicide Package Mixes (continued)

| Herbicide | Group | Components (a. i /gal or % a. i.) | If you apply (per acre) | You have applied a.i. | An equivalent tank mix of (product) |
|---|---|---|---|---|---|
| Keystone LA NXT | 5 | 1.7 lb atrazine | | 0.98 lb atrazine | 1 qt atrazine 4L |
| | | | | | |
| Harness Xtra 5.6L, Confidence Xtra 5.6 | 15 | 3.1 lb acetochlor | 3 qt | 2.325 lb acetochlor | 2.66 pt Harness 7E |
| | | | | | |
| Keystone NXT | 5 | 2.5 lb atrazine | | 1.875 lb atrazine | 1.9 qt atrazine 4L |
| | | | | | |
| Hornet WDG | 2 | 18.5% flumetsulam | 5 oz | 0.924 oz flumetsulam | 1.15 oz Python WDG |
| | 4 | 60% clopyralid | | 0.195 lb clopyralid | 6.68 oz Stinger 3S |
| | | | | | |
| Impact Core | 15 | 7.08 lb acetochlor | 30 oz | 1.66 lb acetochlor | 1.9 pt Harness 7E |
| | 27 | 0.07 lb topramezone | | 0.02 lb toprarmezone | 0.9 oz Impact |
| | | | | | |
| Integrity | 14 | 6.24% saflufenacil | 13 oz | 0.058 lb saflufenacil | 2.6 oz Sharpen |
| | 15 | 55.04% dimethenamid | | 0.5 lb dimethenamid | 10.9 oz Outlook |
| | | | | | |
| Instigate | 2 | 4.17% rimsulfuron | 6.0 oz | 0.25 oz rimsulfuron | 1.5 oz Resolve |
| | 27 | 41.67% mesotrione | | 2.5 oz mesotrione | 5 oz Callisto |
| | | | | | |
| Katagon | 2 | 1.00 lb nicosulfuron | 2.3 fl oz | 0.3 oz nicosulfuron | 0.55 oz Accent Q |
| | 27 | 1.00 lb tolpyralate | | 0.3 oz tolpyralate | 0.7 oz Shieldex 400SC |
| | | | | | |
| Kyber | 5 | 1.5 lb metribuzin | 1.25 pt | 0.23 lb metribuzin | 0.23 lb metribuzin |
| | 14 | 0.5 lb flumioxazin | | 0.07 lb flumioxazin | 2.2 oz Valor |
| | 15 | 0.64 lb pyroxasulfone | | 0.1 lb pyroxasulfone | 1.9 oz Zidua |
| | | | | | |
| Lexar EZ | 15 | 1.74 lb S-metolachlor | 3.5 qt | 1.52 lb S-metolachlor | 1.6 pt Dual II Mag. |
| | 5 | 1.74 lb atrazine | | 1.52 lb atrazine | 3 pt Aatrex 4L |
| | 27 | 0.224 lb mesotrione | | 0.196 lb mesotrione | 6.27 oz Callisto |
| | | | | | |
| Lumax EZ | 27 | 0.268 lb mesotrione | 3 qt | 0.2 lb mesotrione | 6 oz Callisto |
| | 15 | 2.68 lb S-metolachlor | | 2 lb S-metolachlor | 2 pt Dual II MAGNUM |
| | 5 | 1 lb atrazine | | 0.75 lb atrazine | 0.75 qt Aatrex 4L |
| | | | | | |
| NorthStar | 2 | 7.5% primisulfuron | 5.0 oz | 0.375 oz primisulfuron | 0.5 oz Beacon 75SG |
| | 4 | 43.9% dicamba | | 2.20 oz dicamba | 4.4 oz Banvel 4L |
| | | | | | |
| Optill | 14 | 17.8% saflufenacil | 2 oz | 0.35 oz saflufenacil | 1 oz Sharpen |
| | 2 | 50.2% imazethapyr | | 1 oz imazethapyr | 4 oz Pursuit |
| | | | | | |
| Panoflex 50 WSG | 2 | 40% tribenuron | 0.5 oz | 0.2 oz tribenuron | 0.2 oz tribenuron |
| | 2 | 10% thifensulfuron | | 0.05 oz thifensulfuron | 0.1 oz Harmony SG |
| | | | | | |
| Perpetuo | 14 | 0.59 lb flumiclorac | 8 oz | 0.037 lb flumiclorac | - |
| | 15 | 1.71 lb pyroxasulfone | | 0.11 lb pyroxasulfone | 2.1 oz Zidua |
| | | | | | |
| Prequel 45% DF | 2 | 15% rimsulfuron | 2 oz | 0.3 oz rimsulfuron | 1.2 oz Resolve SG |
| | 27 | 30% isoxaflutole | | 0.59 oz isoxaflutole | 1.2 oz Balance Pro |
| | | | | | |

## Corn Herbicide Package Mixes (continued)

| Herbicide | Group | Components (a. i /gal or % a. i.) | If you apply (per acre) | You have applied a.i. | An equivalent tank mix of (product) |
|---|---|---|---|---|---|
| Priority | 14 | 12.3% carfentrazone | 1.0 oz | 0.13 oz carfentrazone | 0.5 oz Aim |
| | 2 | 50% halosulfuron | | 0.51 oz halosulfuron | 0.68 oz Permit |
| Realm Q | 2 | 7.5% rimsulfuron | 4 oz | 0.3 oz rimsulfuron | 1.2 oz Resolve SG |
| | 27 | 31.25% mesotrione | | 1.25 oz mesotrione | 2.5 oz Callisto |
| Resicore | 15 | 2.8 lb acetochlor | 2.5 qt | 1.75 lb acetochlor | 2.0 pt Surpass NXT |
| | 27 | 0.3 lb mesotrione | | 0.188 lb mesotrione | 6.0 oz Callisto |
| | 4 | 0.19 lb clopyralid | | 0.119 lb clopyralid | 5.0 oz Stinger |
| Resolve Q | 2 | 18.4% rimsulfuron | 1.25 oz | 0.23 oz rimsulfuron | 0.9 oz Resolve DF |
| | 2 | 4.0% thifensulfuron | | 0.05 oz thifensulfuron | 0.1 oz Harmony SG |
| Restraint | 15 | 6.4 lb acetochlor | 30 fl oz | 1.5 lb acetochlor | 1.7 pt Harness 7E |
| | 27 | 0.09 lb tolpyralate | | 0.35 oz tolpyralate | 0.85 oz Shieldex 400SC |
| Revulin Q | 27 | 36.8% mesotrione | 4 oz | 1.5 oz mesotrione | 3 oz Callisto |
| | 2 | 14.4% nicosulfuron | | 0.58 oz nicosulfuron | 1.1 oz Accent Q |
| Scorch | 4 | 1 lb gal dicamba | 1.5 pt | 0.187 lb dicamba | 0.37 pt Clarity |
| | 4 | 3.02 lb 2,4-D | | 0.57 lb 2,4-D | 1.1 pt 2,4-D LVE 4 |
| | 4 | 0.75 lb fluroxypyr | | 0.14 lb fluroxypyr | 0.4 pt Starane Ultra |
| Sequence | 9 | 2.25 lbs glyphosate | 4 pt | 1.12 lbs glyphosate | 1.75 pt Touchdown |
| | 15 | 3 lbs S-metolachlor | | 1.5 lbs S-metolachlor | 1.63 pt Dual II MAGNUM |
| Sinate | 10 | 2.47 lb glufosinate | 28 oz | 0.54 lb glufosinate | 30 oz Liberty |
| | | 0.1 lb topramezone | | 0.022 lb topramezone | 1 oz Impact |
| Solstice | 27 | 3.78 lb mesotrione | 3.15 oz | 1.49 oz mesotrione | 3 oz Callisto |
| | 14 | 0.22 lb fluthiacet-methyl | | 0.08 oz fluthiacet-m | 0.75 oz Cadet |
| Spirit 57WG | 2 | 14.25% prosulfuron | 1 oz | 0.1425 oz prosulfuron | 0.25 oz Peak 57WG |
| | 2 | 42.75% primisulfuron | | 0.4275 oz primisulfuron | 0.57 oz Beacon 75SG |
| Spitfire | 4 | 0.5 lb dicamba acid | 2 pt | 0.12 lb ae dicamba | 3.8 oz Banvel |
| | 4 | 3.07 lb ae 2,4-D ester | | 0.77 lb ae 2,4-D | 1.63 pt 2,4-D 4E |
| Status 56WDG | 19 | 17.1 % diflufenzopyr | 5 oz | 0.8 oz diflufenzopyr | 0.8 oz diflufenzopyr |
| | 4 | 44% dicamba | | 0.125 lb dicamba | 4 oz Banvel |
| Steadfast Q | 2 | 25.2% nicosulfuron | 1.5 oz | 0.37 oz nicosulfuron | 0.68 oz Accent Q |
| | 2 | 12.5% rimsulfuron | | 0.19 oz rimsulfuron | 0.76 oz Resolve DF |
| Surestart II/Tripleflex II, Trisidual | 15 | 3.75 lb acetochlor | 2.0 pt | 0.94 lb acetochlor | 1.2 pt Surpass 6.4E |
| | 4 | 0.38 lb clopyralid | | 1.5 oz clopyralid | 4.1 oz Stinger 3S |
| | 2 | 0.12 lb flumetsulam | | 0.48 oz flumetsulam | 0.6 oz Python WDG |

## Corn Herbicide Package Mixes (continued)

| Herbicide | Group | Components (a. i /gal or % a. i.) | If you apply (per acre) | You have applied a.i. | An equivalent tank mix of (product) |
|---|---|---|---|---|---|
| Verdict | 14 | 0.57 lb saflufenacil | 14 oz | 0.06 oz saflufenacil | 0.17 oz Sharpen |
| | 15 | 5 lb dimethenamid-P | | 0.55 oz dimethenamid-P | 0.73 oz Outlook |
| | | | | | |
| WideMatch 1.5EC | 4 | 0.75 lb fluroxypyr | 1.3 pt | 0.125 lb fluroxypyr | 10.6 oz Starane 1.5E |
| | 4 | 0.75 lb clopyralid | | 0.125 lb clopyralid | 5.3 oz Stinger 3S |
| | | | | | |
| Yukon | 2 | 12.5% halosulfuron | 4 oz | 0.5 oz halosulfuron | 0.66 oz Permit |
| | 4 | 55% dicamba | | 0.125 lb dicamba | 4 oz Banvel |

## Soybean Herbicide Premixes or Co-packs and Equivalents

| Herbicide | Group | Components (a. i /gal or % a. i.) | If you apply (per acre) | You have applied a.i. | An equivalent tank mix of (product) |
|---|---|---|---|---|---|
| Afforia | 14 | 40.8% flumioxazin | 3 oz | 1.22 oz flumioxazin | 2.4 oz Valor SX |
| | 2 | 5.0% thifensulfuron | | 0.15 oz thifensulfuron | 0.3 oz Harmony |
| | 2 | 5.0% tribenuron | | 0.15 oz tribenuron | 0.3 oz Express |
| Anthem Maxx | 15 | 4.174 lb pyroxasulfone | 5 oz | 0.16 oz pyroxasulfone | 3 oz Zidua |
| | 14 | 0.126 lb fluthiacet methyl | | 0.08 oz fluthiacet | 0.7 oz Cadet |
| Authority Assist, Zone Assist | 14 | 33.3% sulfentrazone | 10 oz | 0.21 lb sulfentrazone | 5.6 oz Authority 75DF |
| | 2 | 6.67% imazethapyr | | 0.67 oz imazethapyr | 3.4 oz Pursuit AS |
| Authority Edge | 14 | 2.73 lb sulfentrazone | 10 oz | 0.21 lb sulfentrazone | 5.6 oz Authority 75DF |
| | 15 | 1.52 lb pyroxasulfone | | 0.12 lb pyroxasulfone | 2.3oz Zidua |
| Authority Elite, BroadAxe XC, | 14 | 0.7 lb sulfentrazone | 25 oz | 0.14 lb sulfentrazone | 0.19 lb Authority 75DF |
| Zone Elite | 15 | 6.3 lb S-metolachlor | | 1.23 lb S-metolachlor | 0.16 gal Dual II MAGNUM |
| Authority First/Sonic | 14 | 62.1% sulfentrazone | 8.0 oz | 0.31 lb sufentrazone | 6.6 oz Authority 75DF |
| | 2 | 7.96% cloransulam-methyl | | 0.64 oz cloransulam-methyl | 0.76 oz FirstRate |
| Authority MAXX, Zone Maxx | 14 | 62.12% sulfentrazone | 7 oz | 4.3 oz sulfentrazone | 5.7 oz Authority 75DF |
| | 2 | 3.88% chlorimuron | | 0.28 oz chlorimuron | 1.1 oz Classic 25DF |
| Authority MTZ | 14 | 18% sulfentrazone | 16 oz | 0.18 lb sulfentrazone | 3.8 oz Authority 75DF |
| | 5 | 27% metribuzin | | 0.27 lb metribuzin | 0.36 lb Metribuzin 75DF |
| Authority Supreme | 14 | 20.66% sulfentrazone | 10 oz | 0.13 lb sulfentrazone | 0.17 lb Authority 75DF |
| | 15 | 20.66% pyroxasulfone | | 0.13 lb pyroxasulfone | 2.4 oz Zidual |
| Authority XL | 14 | 62.2% sulfentrazone | 8 oz | 5.0 oz sulfentrazone | 6.6 oz Authority 75DF |
| | 2 | 7.8% chlorimuron | | 0.6 oz chlorimuron | 2.4 oz Classic |
| Boundary 7.8EC, Presidual | 15 | 5.2 lbs S-metolachlor | 2.1 pt | 1.4 lb S-metolachlor | 1.5 pt Dual II MAG. |
| | 5 | 1.25 lbs metribuzin | | 0.3 lb metribuzin | 0.4 lb Metribuzin 75DF |
| Canopy 75DF | 2 | 10.7% chlorimuron-ethyl | 6 oz | 0.5 oz chlorimuron | 2.0 oz Classic 25DF |
| | 5 | 64.3% metribuzin | | 3 oz metribuzin | 0.25 lb Metribuzin 75DF |
| Canopy EX | 2 | 22.7% chlorimuron | 1.5 oz | 0.34 oz chlorimuron | 1.36 oz Classic |
| | 2 | 6.8% tribenuron | | 0.10 oz tribenuron | 0.10 oz tribenuron |
| Cheetah Max | 10 | 2 lb glufosinate | 34 oz | 0.53 lb glufosinate | 1.81 pt Liberty |
| | 14 | 1 lb fomesafen | | 0.27 lb fomesafen | 1.13 pt Flexstar |
| Crusher | 2 | 25% rimsulfuron | 1 oz | 0.25 oz rimsulfuron | 1.0 oz Resolve DF |
| | 2 | 25% thifensulfuron | | 0.25 oz thifensulfuron | 0.5 oz Harmony SG |

## Soybean Herbicide Package Mixes (continued)

| Herbicide | Group | Components (a. i /gal or % a. i.) | If you apply (per acre) | You have applied a.i. | An equivalent tank mix of (product) |
|---|---|---|---|---|---|
| Enlist Duo | 4 | 1.6 lb ae 2,4-D choline salt | 4 pt | 0.8 lb ae 2,4-D | 1.63 pt 2,4-D 4A |
| | 9 | 1.7 lb ae glyphosate | | 0.85 lb ae glyphosate | 1.5 pt Roundup WMax |
| | | | | | |
| Enlite 47.9DG | 14 | 36.2% flumioxazin | 2.8 oz | 1.0 oz flumioxazin | 2.0 oz Valor |
| | 2 | 8.8% thifensulfuron | | 0.25 oz thifensulfuron | 0.5 oz Harmony SG |
| | 2 | 2.8% chlorimuron ethyl | | 0.08 oz chlorimuron ethyl | 0.32 oz Classic 25 DF |
| | | | | | |
| Envive 41.3DG | 14 | 29.2% flumioxazin | 3.5 oz | 1.0 oz flumioxazin | 2.0 oz Valor |
| | 2 | 2.9% thifensulfuron | | 0.10 oz thifensulfuron | 0.2 oz Harmony SG |
| | 2 | 9.2% chlorimuron ethyl | | 0.32 oz chlorimuron ethyl | 1.3 oz Classic 25DF |
| | | | | | |
| Extreme | 2 | 1.8% imazethapyr | 3 pt | 1.02 oz imazethapyr | 4 oz Pursuit 2AS |
| | 9 | 22% glyphosate | | 0.75 lb glyphosate | 1.5 pt Roundup |
| | | | | | |
| Fierce 76% WDG | 14 | 33.5 % flumioxazin | 3 oz | 1.0 oz flumioxazin | 2.0 oz Valor |
| | 15 | 42.5% pyroxasulfone | | 1.28 oz pyroxasulfone | 1.5 oz Zidua |
| | | | | | |
| Fierce XLT | 14 | 24.57% flumioxazin | 4 oz | 1.0 oz flumioxazin | 2.0 oz Valor |
| | 15 | 31.17% pyroxasulfone | | 1.28 oz pyroxasulfone | 1.5 oz Zidua |
| | 2 | 6.67% chlorimuron | | 0.25 oz chlorimuron | 1 oz Classic DF |
| | | | | | |
| Flexstar GT 3.5 | 14 | 0.56 lb fomesafen | 3.5 pt | 0.245 lb fomesafen | 1 pt Flexstar |
| | 9 | 2.26 lb glyphosate | | 1.0 lb glyphosate | 1.63 pt Touchdown HiTech |
| | | | | | |
| Fusion 2.67E | 1 | 2 lb fluazifop | 8 fl oz | 0.125 lb fluazifop | 8 fl oz Fusilade DX 2E |
| | 1 | 0.67 lb fenoxaprop | | 0.67 oz fenoxaprop | 8 fl oz Option II 0.67E |
| | | | | | |
| Harrow | 2 | 50% rimsulfuron | 0.5 oz | 0.25 oz rimsulfuron | 1 oz Matrix SG |
| | 2 | 25% thifensulfuron | | 0.12 oz thifensulfuron | 0.25 oz Harmony SG |
| | | | | | |
| Kyber | 5 | 1.5 lb metribuzin | 1.25 pt | 0.23 lb metribuzin | 0.23 lb metribuzin |
| | 14 | 0.5 lb flumioxazin | | 0.07 lb flumioxazin | 2.2 oz Valor |
| | 15 | 0.64 lb pyroxasulfone | | 0.1 lb pyroxasulfone | 1.9 oz Zidua |
| | | | | | |
| Latir | 14 | 31.5% flumioxazin | 3.2 oz | 1 oz flumioxazin | 2 oz Valor |
| | 2 | 23.5% imazethapyr | | 0.75 oz imazethapyr | 3 oz Pursuit |
| | | | | | |
| Marvel | 14 | 1.2% fluthiacet | 5 oz | 0.075 oz fluthiacet | 0.66 oz Cadet |
| | 14 | 30.08% fomesafen | | 1.8 oz fomesafen | 0.5 pt Flexstar |
| | | | | | |
| Matador | 15 | 4 lb metolachlor | 2 pt | 1 lb metolachlor | 1 pt Stalwart |
| | 5 | 0.56 lb metribuzin | | 2.25 oz metribuzin | 3 oz Metribuzin 75DG |
| | 2 | 0.13 lb imazethapyr | | 2 oz imazethapyr | 2 oz Pursuit 2AS |
| | | | | | |
| OpTill | 14 | 17.8% saflufenacil | 2 oz | 0.35 oz saflufenacil | 1 oz Sharpen |
| | 2 | 50.2% imazethapyr | | 1.0 oz imazethapyr | 4 oz Pursuit AS |
| | | | | | |

## Soybean Herbicide Package Mixes (continued)

| | | | | | |
|---|---|---|---|---|---|
| Panoflex 50% WSG | 2 | 40% tribenuron | 0.5 oz | 0.2 oz tribenuron | 0.2 oz tribenuron |
| | 2 | 10% thifensulfuron | | 0.05 oz thifensulfuron | 0.1 oz Harmony SG |
| | | | | | |
| Panther Pro | 14 | 0.67 lb flumioxazin/gal | 12 oz | 0.06 lb flumioxazin | 2 fluid oz Panther SC |
| | 2 | 0.56 lb imazethapyr | | 0.053 lb imazethapyr | 3.2 fluid oz Pursuit |
| | 5 | 3 lb metribuzin | | 0.28 lb metribuzin | 6 oz of a metribuzin 75% WDG |
| | | | | | |
| Perpetuo | 14 | 0.59 lb flumiclorac | 8 oz | 0.037 lb flumiclorac | - |
| | 15 | 1.71 lb pyroxasulfone | | 0.11 lb pyroxasulfone | 2.1 oz Zidua |
| | | | | | |
| Prefix | 15 | 46.4% S-metolachlor | 2 pt | 1.09 lb S-metolachlor | 1.14 pt Dual Magnum |
| | 14 | 10.2% fomesafen | | 0.238 lb fomesafen | 0.95 pt Reflex |
| | | | | | |
| Pummel | 15 | 5.0 lb metolachlor | 2 pt | 1.25 lb metolachlor | 1.2 pt Stalwart |
| | 2 | 0.25 lb imazethapyr | | 1 oz imazethapyr | 4 oz Pursuit |
| | | | | | |
| Pursuit Plus 2.9E | 2 | 0.2 lb imazethapyr | 2.5 pt | 0.063 lb imazethapyr | 4.0 oz Pursuit 2S |
| | 3 | 2.7 lb pendimethalin | | 0.84 lb pendimethalin | 2.00 pt Prowl 3.3E |
| | | | | | |
| Rowel FX | 2 | 10.3% chlorimuron ethyl | 5 oz | 0.52 oz chlorimuron ethyl | 0.21 oz Classic |
| | 14 | 30% flumioxazin | | 1.5 oz flumioxazin | 2.94 oz Valor |
| | | | | | |
| Sequence 5.25L | 15 | 3.0 lb S-metolachlor | 3 pt | 1.13 lb S-metolachlor | 1.2 pt Dual Magnum |
| | 9 | 2.25 lb glyphosate | | 0.84 lb ae glyphosate | 1.63 pt Touchdown |
| | | | | | |
| Sonic | 14 | 6.21% sulfentrazone | 8.0 oz | 0.361 lb sulfentrazone | 6.6 oz Authority 75DF |
| | 2 | 7.96% cloransulam-methyl | | 0.64 oz cloransulam-methyl | 0.76 oz FirstRate |
| | | | | | |
| Statement | 15 | 4.22 lb metolachlor | 2 pt | 1.1 lb metolachlor | 1.1 pt Stalwart |
| | 14 | 0.91 lb fomesafen | | 0.23 lb fomesafen | 15.3 oz Rhythm |
| | | | | | |
| Storm 4S | 6 | 2.67 lb bentazon | 1.5 pt | 0.50 lb bentazon | 1 pt Basagran 4S |
| | 14 | 1.33 lb acifluorfen | | 0.25 lb acifluorfen | 1 pt Blazer 2S |
| | | | | | |
| Surveil | 14 | 51% flumioxazin | 3.6 oz | 1.5 oz flumioxazin | 3.0 oz Valor |
| | 2 | 84% chloransulam | | 0.5 oz cloransulam | 0.6 ox FirstRate |
| | | | | | |
| Synchrony NXT | 2 | 21.5% chlorimuron | 0.5 oz | 0.11 oz chlorimuron | 0.44 oz Classic 25DF |
| | 2 | 6.9% thifensulfuron | | 0.034 oz thifensulfuron | 0.068 oz Harmony SG |
| | | | | | |
| Tailwind | 15 | 5.25 lb metolachlor | 2 pt | 1.3 lb metolachlor | 1.3 pt Stalwart 8E |
| | 5 | 1.25 lb metribuzin | | 0.31 lb metribuzin | 0.4 lb Metribuzin 75DF |
| | | | | | |
| Tavium plus VGT | 4 | 1.12 lb dicamba a.e. | 56.5 fl oz | 0.5 lb dicamba | 22 oz Xtendimax w/VGT |
| | 15 | 2.26 lb s-metolachlor | | 1.0 lb s-metolachlor | 1.0 pt Dual Magnum |
| | | | | | |
| Torment | 14 | 2.0 lb fomesafen | 1 pt | 0.25 lb fomesafen | 2.1 pt Flexstar |
| | 2 | 0.5 lb imazethapyr | | 1 oz imazethapyr | 4 oz Pursuit |

## Soybean Herbicide Package Mixes (continued)

| Herbicide | Group | Components (a. i /gal or % a. i.) | If you apply (per acre) | You have applied a.i. | An equivalent tank mix of (product) |
|---|---|---|---|---|---|
| Trivence WDG | 2 | 3.9% chlorimuruon-ethyl | 6 oz | 0.23 oz chlorimuron | 1.0 oz Classic 25DF |
| | 14 | 12.8% flumioxazin | | 0.77 oz flumioxazin | 1.5 oz Valor |
| | 5 | 44.6% metribuzin | | 2.68 oz metribuzin | 0.22 lb Metribuzin 75DF |
| | | | | | |
| Valor XLT | 14 | 30.3% flumioxazin | 3 oz | 0.9 oz flumioxazin | 1.76 oz Valor |
| | 2 | 10.3% chlorimuron ethyl | | 0.3 oz chlorimuron | 1.24 oz Classic |
| | | | | | |
| Varisto | 6 | 4.0 lb bentazon | 27 oz | 0.84 lb bentazon | 0.84 qt Basagran |
| | 2 | 0.187 lb imazamox | | 0.64 oz imazamox | 5.1 oz Raptor |
| | | | | | |
| Warrant Ultra | 15 | 2.82 lb acetochlor | 50 oz | 1.1 lb acetochlor | 3 pt Warrant |
| | 14 | 0.63 lb fomesafen | | 0.25 lb fomesafen | 1 pt Reflex |
| | | | | | |
| Zidua Pro | 14 | 0.48 lbs saflufenacil | 4.5 oz | 0.26 oz saflufenacil | 0.73 oz Sharpen |
| | 2 | 1.33 lbs imazethapyr | | 0.75 oz imazethapyr | 3 oz Pursuit |
| | 15 | 2.28 lbs pyroxasulfone | | 1.28 oz pyroxasulfone | 1.5 oz Zidua |
| | | | | | |
| ZoneDefense | 14 | 62% sulfentrazone | 5 oz | 3.1 oz sulfentrazone | 6.2 oz Spartan |
| | 14 | 15% flumioxazin | | 0.8 oz flumioxazin | 1.6 oz Valor SX |

## Herbicide Sites of Action

**Table 1. Herbicide classification by group number and site of action**

| Group No. | Site of Action (mode of action) | Examples |
|---|---|---|
| 1 | ACC-ase (lipid synthesis) | Poast, Select |
| 2 | ALS (amino acid synthesis) | Pursuit, Classic, Accent |
| 3 | Tubulin (cell division) | Treflan, Prowl |
| 4 | Auxin binding site (synthetic auxin) | 2,4-D; Clarity |
| 5 | D1 protein (Photosystem II inhibition) | atrazine, metribuzin |
| 6 | D1 protein (Photosystem II inhibition) | Basagran |
| 7 | D1 protein (Photosystem II inhibition) | linuron |
| 9 | EPSPS (shikimic acid pathway inhibition) | Roundup, glyphosate |
| 10 | Glutamine synthetase (photosynthesis inhibition) | Liberty |
| 13 | DPX synthase (carotene synthesis) | Command |
| 14 | PPO (chlorophyll synthesis) | Cobra, Flexstar, Valor, Authority |
| 15 | Unknown (VLC fatty acid synthesis) | Dual II Magnum, Harness, Zidua |
| 19 | Auxin transport | NA |
| 22 | Photosystem I | Paraquat |
| 27 | HPPD (carotene synthesis) | Callisto, Balance |

**Table 2. Active ingredients and group numbers of single ingredient products.**

| Trade name | Herbicide Group No. | Active ingredient |
|---|---|---|
| 2,4-D, Enlist One/Duo, and others | 4 | 2,4-D |
| Accent Q | 2 | nicosulfuron |
| Aim | 14 | carfentrazone |
| Assure II | 1 | quizalofop |
| atrazine | 5 | atrazine |
| Autumn | 2 | iodosulfuron |
| Balance Flexx | 27 | isoxaflutole |
| Banvel/Clarity/DiFlexx/Xtendimax/Engenia | 4 | dicamba |
| Basagran | 6 | bentazon |
| Beacon | 2 | primisulfuron |
| Buctril | 6 | bromoxynil |
| Cadet | 14 | fluthiacet-ethyl |
| Callisto | 27 | mesotrione |
| Classic | 2 | chorimuron |
| Cobra | 14 | lactofen |
| Command | 13 | clomazone |
| Dual/Cinch | 15 | S-metolachlor |
| Express | 2 | tribenuron |
| FirstRate | 2 | cloransulam |
| FlexStar/Reflex | 14 | fomesafen |
| Fusilade DX | 1 | fluazifop |
| Gramoxone SL/Parazone | 22 | paraquat |

**Table 2. Active ingredients and group numbers of single ingredient products.** (continued)

| Trade name | Herbicide Group No. | Active ingredient |
|---|---|---|
| Harmony | 2 | thifensulfuron |
| Harness/Surpass/Breakfree/Warrant | 15 | acetochlor |
| Impact/Armezon | 27 | topramezone |
| Laudis | 27 | tembotrione |
| Liberty | 10 | glufosinate |
| Lorox/Linex | 7 | linuron |
| Metribuzin/TriCor/Sencor | 5 | metribuzin |
| Option | 2 | foramsulfuron |
| Outlook | 15 | dimethenamid |
| Peak | 2 | prosulfuron |
| Permit | 2 | halosulfuron |
| Poast | 1 | sethoxydim |
| Prowl | 3 | pendimethalin |
| Pursuit | 2 | imazethapyr |
| Python | 2 | flumetsulam |
| Raptor | 2 | imazamox |
| Resolve/Bestow | 2 | rimsulfuron |
| Resource | 14 | flumiclorac |
| Roundup/Touchdown | 9 | glyphosate |
| Scepter | 2 | imazaquin |
| Select | 1 | clethodim |
| Sharpen | 14 | saflufenacil |
| Shieldex | 27 | topryalate |
| Sonalan | 3 | ethalfluralin |
| Spartan/Authority | 14 | sulfentrazone |
| Stinger | 4 | clopyralid |
| Tough | 6 | pyridate |
| Treflan/Thrust | 3 | trifluralin |
| UltraBlazer | 14 | acifluorfen |
| Valor/Rowel/Panther SC | 14 | flumioxazin |
| Warrant | 15 | acetochlor |
| Zidua | 15 | pyroxasulfone |
| Only sold in premix | 2 | thiencarbazone |
| Only sold in premix | 19 | diflufenzopyr |
| Only sold in premix | 1 | fenoxaprop |
| Only sold in premix | 27 | bicyclA62:C82 |

**Table 3. Active ingredients and group numbers of herbicide premixes.**

| Trade name | Herbicide Group No. | Active ingredient |
|---|---|---|
| Acuron | 5, 15, 27, 27 | atrazine, S-metolachlor, mesotrione, bicyclopyrone |
| Acuron Flexi | 15, 27, 27 | S-metolachlor, mesotrione, bicyclopyrone |
| Afforia | 2, 2, 14 | thifensulfuron, tribenuron, flumioxazin |
| Alluvex | 2, 2 | rimsulfuron, thifensulfuron |
| Anthem | 14, 15 | fluthiacet, pyroxasulfone |
| Anthem ATZ | 5, 14, 15 | atrazine, fluthiacet, pyroxasulfone |
| Anthem Maxx | 14, 15 | fluthiacet, pyroxasulfone |
| Armezon Pro | 15, 27 | dimethenamid-P, topramezone |
| Authority Assist | 2, 14 | imazethapyr, sulfentrazone |
| Authority Edge/Authority Supreme | 14, 15 | sulfentrazone, pyroxasulfone |
| Authority Elite | 14, 15 | sulfentrazone, S-metolachlor |
| Authority MTZ | 5, 14 | metribuzin, sulfentrazone |
| Authority XL | 2, 14 | chlorimuron, sulfentrazone |
| Autumn Super | 2, 2 | iodosulfuron, thiencarbazone |
| Basis Blend | 2, 2 | rimsulfuron, thifensulfuron |
| Bicep | 5, 15 | atrazine, S-metolachlor |
| Boundry | 15, 5 | S-metolachlor, metribuzin |
| Breakfree NXT ATZ, Breakfree NXT Lite | 5, 15 | atrazine, acetochlor |
| BroadAxe | 14, 15 | sulfentrazone, S-metolachlor |
| Callisto GT | 9, 27 | glyphosate, mesotrione |
| Callisto Xtra | 5, 27 | atrazine, mesotrione |
| Canopy | 2, 5 | chloriuron, metrbuzin |
| Canopy EX | 2, 2 | chlorimuron, tribenuron |
| Capreno | 2, 27 | thiencarbazone, tembotrione |
| Charger Max ATZ | 5, 15 | atrazine, S-metolachlor |
| Cheetah Max | 10, 14 | glufosinate, fomesafen |
| Cinch ATZ | 15, 5 | S-metolachlor, atrazine |
| Confidence Xtra | 5, 25 | atrazine, acetochlor |
| Corvus | 2, 27 | thiencarbazone, isoxaflutole |
| Crusher | 2, 2 | rimsulfuron, thifensulfuron |
| Degree Xtra | 5, 15 | atrazine, acetochlor |
| DiFlexx | 4, 27 | dicamba, isoxaflutole |
| Diflexx Duo | 4, 27 | dicamba, tembotrione |
| Enlist Duo | 4, 9 | 2,4-D, glyphosate |
| Enlite | 2, 2, 14 | chlorimuron, thifensulfuron, flumioxazin |
| Envive | 2, 2, 14 | chloriuron, thifensulfuron, flumioxazin |
| Expert | 5, 9, 15 | atrazine, glyphosate, S-metolachlor |
| Extreme | 2, 9 | imazethapyr, glyphosate |
| Fierce | 14, 15 | flumioxazin, pyroxasulfone |
| Fierce XLT | 2, 14, 15 | chlorimuron, flumioxazin, pyroxasulfone |
| Flexstar GT | 9, 14 | glyphosate, fomesafen |
| FulTime NXT | 5, 15 | atrazine, acetochlor |
| Fusion | 1, 1 | fenoxaprop, fluazifop |
| Halex GT | 9, 15, 27 | glyphosate, S-metolachlor, mesotrione |

**Table 3. Active ingredients and group numbers of herbicide premixes.** (continued)

| Trade name | Herbicide Group No. | Active ingredient |
|---|---|---|
| Harness MAX | 15, 27 | acetochlor, mesotrione |
| Harness Xtra | 5, 15 | atrazine, acetochlor |
| Harrow | 2, 2 | rimsulfuron, thifensulfuron |
| Impact Core | 15, 27 | acetochlor,topramezone |
| ImpactZ | 5, 27 | atrazine, topramezone |
| Instigate | 2, 27 | rimsulfuron, mesotrione |
| Keystone NXT, Keystone LA NXT | 5, 15 | atrazine, acetochlor |
| Kyber | 5, 14, 15 | metribuzin, flumioxazin, pyroxasulfone |
| Latir | 2, 14 | imazethapyr, flumioxazin |
| Lexar EZ | 5, 15, 27 | atrazine, S-metolachlor, mesotrione |
| Lumax EZ | 5, 15, 27 | atrazine, S-metolachlor, mesotrione |
| Marksman | 4, 5 | dicamba, atrazine |
| Marvel | 14,14 | fluthiacet, fomesafen |
| Northstar | 2, 4 | primisulfuron, dicamba |
| Optill | 2, 14 | imazethapyr, saflufenacil |
| Panoflex | 2, 2 | tribenuron, thifensulfuron |
| Panther Pro | 2, 5, 14 | imazethapyr, metribuzin, flumioxazin |
| Perpetuo | 14, 15 | flumiclorac, pyroxasulfone |
| Permit Plus | 2, 2 | halosulfuron, thifensulfuron |
| Prefix | 14, 15 | fomesafen, S-metolachlor |
| Presidual | 5, 15 | metribuzin, S-metolachlor |
| Prequel | 2, 27 | rimsulfuron, isoxaflutole |
| Priority | 2, 14 | halosulfuron, carfentrazone |
| Pummel | 2, 15 | imazethapyr, metolachlor |
| Pursuit Plus | 2, 3 | imazethapyr, pendimethalin |
| Realm Q | 2, 27 | rimsulfuron, mesotrione |
| Require Q | 2, 4 | rimsulfuron, dicamba |
| Resicore | 4, 15, 27 | clopyralid, acetochlor, mesotrione |
| Resolve Q | 2, 2 | rimsulfuron, thifensulfuron |
| Revulin Q | 2, 27 | nicosulfuron, mesotrione |
| Rowel FX | 2, 14 | chlorimuron ethyl, flumioxazin |
| Scorch | 4, 4, 4 | 2,4-D, dicamba, fluroxypyr |
| Sinate | 10, 27 | glufosinate, topramezone |
| Sequence | 9, 15 | glyphosate, S-metolachlor |
| Sinate | 10, 27 | glufosinate, topramezone |
| Solstice | 14, 27 | fluthiacet, mesotrione |
| Sonic | 2, 14 | cloransulam, sulfentrazone |
| Spirit | 2, 2 | primisulfuron, prosulfuron |

**Table 3. Active ingredients and group numbers of herbicide premixes.** (continued)

| Trade name | Herbicide Group No. | Active ingredient |
|---|---|---|
| Spitfire | 4, 4 | 2,4-D, dicamba |
| Statement | 15, 14 | metolachlor, fomesafen |
| Status | 4, 19 | dicamba, diflufenzopyr |
| Steadfast Q | 2, 2 | nicosulfuron, rimsulfuron |
| Surpass NXT | 5, 15 | atrazine, acetochlor |
| Surestart | 2, 4, 15 | flumetsulam, clopyralid, acetochlor |
| Surveil | 2,14 | cloransulam, flumioxazin |
| Synchrony | 2, 2 | chlorimuron, thifensulfuron |
| Tailwind | 5, 15 | metribuzin, metolachlor |
| Tavium plus VGT | 4, 15 | dicamba, s-metolochlor |
| Torment | 2, 14 | imazethapyr, fomesafen |
| TripleFLEX II | 2, 4, 15 | flumetsulam, clopyralid, acetochlor |
| Trisidual | 2, 4, 15 | flumetsulam, clopyralid, acetochlor |
| Trivence | 2, 5, 14 | chlorimuron, metribuzin, flumioxazin |
| Valor XLT | 2, 14 | chlorimuron, flumioxazin |
| Varisto | 2, 6 | imazamox, bentazon |
| Verdict | 14, 15 | saflufenacil, dimethenamid |
| Warrant Ultra | 14, 15 | fomesafen, acetochlor |
| Weedmaster | 4, 4 | 2,4-D, dicamba |
| Yukon | 2, 4 | halosulfuron, dicamba |
| Zemax | 15, 27 | S-metolachlor, mesotrione |
| Zidua Pro | 2, 14, 15 | imazethapyr, saflufenacil, pyroxasulfone |
| Zone Defense | 14, 14 | sulfentrazone, flumioxazin |
| Zone Assist | 2, 14 | imazethapyr, sulfentrazone |
| Zone Elite | 14, 15 | sulfentrazone, S-metolachlor |
| Zone Maxx | 2, 14 | chlorimuron, sulfentrazone |

## ACCase inhibitor HG 1 .

| | |
|---|---|
| **aryloxyphenoxy-propanoate** | |
| Assure II, others | quizalofop-p-ethyl |
| Fusilade DX | fluazifop-p-butyl |
| Fusion | fluazifop-p-butyl + fenoxaprop |
| Hoelon | diclofop |
| **cyclohexanediones** | |
| Poast, Poast Plus | sethoxydim |
| Select, Section, Arrow, others | clethodim |

## ALS inhibitors HG 2 .

| | |
|---|---|
| **imidazolinones** | |
| Pursuit | imazethapyr |
| Raptor | imazamox |
| Scepter | imazaquin |
| **sulfonanilides** | |
| FirstRate, Amplify | chloransulam |
| Python | flumetsulam |
| **sulfonylureas** | |
| Accent | nicosulfuron |
| Ally, Cimarron | metsulfuron |
| Beacon | primisulfuron |
| Classic | chlorimuron |
| Express | tribenuron |
| Harmony GT | thifensulfuron |
| Permit, Halofax | halosulfuron |

## ALS inhibitors HG 2 .

| | |
|---|---|
| **dinitroanilines** | |
| Balan | benefin |
| Prowl H20, Pendimax, Frame-work, Satellite, others | pendimethalin |
| Sonalan | ethalfluralin |
| Surflan | oryzalin |
| Treflan, Trust, others | trifluralin |

## Synthetic auxin HG 4

| | |
|---|---|
| **benzoic** | |
| Banvel, Clarity, DiFlexx, Sterling Blue, others | dicamba |
| **phenoxy** | |
| many | MPCA |
| many | 2,4-D |
| Butyrac, Butoxone | 2,4-DB |
| **pyridines** | |
| Remedy Ultra, Pathfinder II, many others | triclopyr |
| Milestone | aminopyralid |
| Stinger, Transline | clopyralid |
| Streamline | aminocyclopyrachlor |
| Tordon | picloram |

## Photosystem II inhibitors HG 5, 6, 7

| | |
|---|---|
| **benzothiadiazole** | |
| Basagran, Broadlawn | bentazon |
| nitriles | |
| Buctril, others | bromoxynil |
| **triazines** | |
| AAtrex, atrazine, others | atrazine |
| Evik | ametryn |
| Metribuzin, Tricor | metribuzin |
| Princep | simazine |
| **ureas** | |
| Karmex | diuron |
| LInex, Lorox | linuron |

## Glutamine synthetase inhibitors HG 10

| | |
|---|---|
| Liberty, Cheetah | glufosinate |

## Diterpene inhibitors HG 13

| | |
|---|---|
| Command | clomazone |

## ALS inhibitors HG 2 .

| | |
|---|---|
| **aryl triazolinones** | |
| Aim | carfentrazone |
| Authority, Spartan | sulfentrazone |
| diphenyl ethers | |
| Blazer, UltraBlazer | acifluorfen |
| Cobra, Phoenix | lactofen |
| ET, Vida | pyraflufen |
| **Flexstar, Reflex** | fomesafen |
| Goal | oxyfluorfen |
| **phenylphthalimides** | |
| Resource | flumiclorac |
| Valor, Rowel | flumioxazin |
| pyrimidinedione | |
| Sharpen (Kixor) | saflufenacil |
| **other** | |
| Cadet | fluthiacet |

## Photosystem II inhibitors HG 5, 6, 7

| | |
|---|---|
| Balance Flexx | isoxaflutole |
| Callisto | mesotrione |
| Armezon/Impact | topramezone |
| Laudis | tembotrione |
| bicyclopyrone | bicyclopyrone |

## Lipid synthesis inhibitors HG 15

| | |
|---|---|
| Harness, Surpass, Warrant | acetochlor |
| Dual II MAGNUM, Cinch, Medal, Charger Max, others | S-metolachlor, metolachlor |
| Frontier, Outlook, Commit, others | dimethenamid-P |
| Zidua | pyroxasulfone |

## Photosystem I inhibitors HG 22

| | |
|---|---|
| Diquat, Reward | diquat |
| Gramoxone Max | paraquat |

## Enolpyruvyl shikimate phosphate synthase (EPSPS) inhibitors HG 9

| | |
|---|---|
| Roundup, Touchdown, others | glyphosate |

## Auxin transport inhibitors HG 19

| | |
|---|---|
| Distinct, Status | diflufenzopyr |