Sulfonylurea (SU) herbicides have been commonly used for postemergence weed control in agronomic crops since the mid-1980’s. This chemical family has been extensively developed and is currently the most populous group of related herbicides. The reason for this great proliferation has been due to the high selectivity of these herbicides to a wide range of plant species. Selectivity is most often due to differential plant metabolism between species; rapid metabolism translates into plant tolerance while slow metabolism results in plant injury or death. With small changes in molecular structure the speed of metabolism is altered and large differences in herbicide selectivity have occurred. Over time, the basic SU structure has been manipulated and herbicides have been developed that are non-injurious to many desirable plant species.

The SU family of herbicides is now being rapidly introduced into the turfgrass market. Managers now have more weed control options than ever before. However, with the introduction of new herbicides can come a relatively steep learning curve. For example, some SU’s require watering after application, others do not. Similarly, some SU’s recommend the use of surfactants and others do not. SU’s should never be applied within seven days of organophosphate insecticides to avoid excessive herbicide injury. Most importantly, turfgrass tolerance can vary widely between seemingly similar herbicides. For example, halosulfuron (Manage) can be safely applied for sedge (Cyperus spp.) control in both cool- and warm-season turfgrasses. Conversely, trifloxysulfuron (Monument) adequately controls sedges, but will cause significant injury
to, or loss of, some cool-season turfgrasses. Therefore, the simple mistake of confusing two SU herbicides can have severe consequences.

Although turfgrass managers have several new SU’s for weed control, the speed at which these herbicides are coming to market can make it difficult to recall which herbicide is most useful for a given situation. The intention of this article is to produce a quick reference to detail turfgrass tolerance (Table 1) and weed control (Table 2) for all sulfonylurea herbicides that are currently used, or being developed, for use in turfgrass weed control.

**Chlorsulfuron (Corsair)**

**General**: Selective control of tall fescue, ryegrass spp., wild garlic, Virginia buttonweed and other grass and broadleaf weed species.

**Tolerant Turfgrasses**: Chlorsulfuron can be applied postemergence to all turfgrass species except tall fescue and ryegrass. St. Augustinegrass, centipedegrass, and zoysiagrass may show discoloration after chlorsulfuron application.

**Use Pattern**: Chlorsulfuron may be used as a transition aid for removing overseeded perennial ryegrass. Clump tall fescue and ryegrass may also be removed from tolerant turfgrasses (particularly Kentucky bluegrass) with this herbicide. Chlorsulfuron may be applied as broadcast applications on golf courses, but only as spot treatments on home lawns. Chlorsulfuron cannot be applied to golf tees or greens.

**Application Rate**: Chlorsulfuron may be applied at rates from 1.0 to 5.33 ozs./acre, depending upon weed species. Annual ryegrass can be controlled with 1 oz./acre while clump-type tall fescue may require two applications of the 5.33 ozs./acre rate. A
nonionic surfactant should be added to the spray solution at a rate of 0.2 to 0.25% v/v (0.7 to 1 qt per 100 gal.).

**Weeds Controlled:** Previous research has shown that chlorsulfuron provides >90% control of ryegrass and wild mustard. Other weeds such as white clover, wild violet, and Virginia buttonweed are suppressed by chlorsulfuron (<70% control). Repeat applications or the addition of auxin-like herbicides (2,4-D, dicamba, etc.) may be used to improve the control of these particularly troublesome weeds. Specific rates to control other weeds are shown on the product label.

**Flazasulfuron (Katana)** – (Registration Pending)

**General:** Flazasulfuron is currently being developed by ISK Biosciences for the control of tall fescue, annual and perennial ryegrass, broadleaf weeds and sedges in bermudagrass and zoysiagrass.  
  
**Tolerant Turfgrasses:** Bermudagrass and zoysiagrass are tolerant to flazasulfuron. Centipedegrass also possesses tolerance, but commonly shows growth regulation and off color after application. Tall fescue, perennial ryegrass, Kentucky bluegrass and St. Augustinegrass are intolerant to flazasulfuron.  

**Overseeding Restriction:** Perennial ryegrass can be overseeded 2 to 12 weeks after application, depending upon rate.  

**Use Pattern:** If registered, flazasulfuron will be used for the control of seedling crabgrass, sedges, certain broadleaf weeds, annual bluegrass and other weedy cool-season grasses, and as a spring transition aid in overseeded bermudagrass.
**Application Rate:** Flazasulfuron has undergone extensive testing in the field by universities at a wide range of rates. Exact rates are not known at this time as this product is still in development, but will likely be in the 1.5 to 3.0 ozs./acre range.

**Weeds Controlled:** Flazasulfuron provides near 100% control of annual and perennial rye grass, tall fescue, white clover, and common chickweed. Control of crabgrass with flazasulfuron has been observed to range between 50 to 95%, depending upon size at time of application. For best control, crabgrass should be treated at the seedling growth stage. Good control of various sedge species has also been noted. The addition of MSMA and 2,4-D can improve control of sedges and dichondra, respectively. Since flazasulfuron is currently under the final stages of development and registration, it is not known which herbicides will be recommended for tank-mixing with flazasulfuron.

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**Foramsulfuron (Revolver)**

**General:** Control of weedy cool-season grasses and goosegrass in bermudagrass and ‘Meyer’ zoysiagrass.

**Tolerant Turfgrasses:** Several bermudagrass cultivars (such as Tifway, ‘Tifsport’, ‘Tifdwarf’, ‘Vamont’, Common and others) and ‘Meyer’ zoysiagrass have shown good tolerance to foramsulfuron. Centipedegrass and all cool-season grasses, such as fescues, ryegrasses, bentgrasses, and bluegrasses, are intolerant to this herbicide.

**Use Pattern:** Foramsulfuron will be used to control *Poa* spp., goosegrass, ryegrass and bentgrass in tolerant warm-season turfgrasses, including bermudagrass greens. This herbicide is also effective for the removal of “clump” fescue and ryegrass. Foramsulfuron is also labeled for use as a spring transition aid in overseeded bermudagrass. Foramsulfuron is not labeled for use on residential lawns.
**Overseeding Restriction:** Ryegrass can be overseeded in treated areas two weeks after application.

**Application:** Foramsulfuron is the first liquid SU and is used at rates of 4.4 to 26.2 fl. oz/acre. No surfactant is required. Multiple applications may be required to control goosegrass or large volunteer ryegrass. Herbicidal activity is greatest if rainfall or irrigation does not occur within 2 hours of treatment. Foramsulfuron can be tracked and damage susceptible cool-season turfgrasses if spray droplets are not allowed to dry before traffic is permitted. Additionally, tracking can occur from morning dew the day after treatment. Irrigation the morning after foramsulfuron application and leaving a 15-foot buffer area around creeping bentgrass areas are recommended procedures that will prevent tracking problems.

**Weeds Controlled:** Foramsulfuron provides excellent control (>90%) of many troublesome cool-season grass species such as *Poa annua*, ryegrass, and clump fescue. Additionally it is quite effective for the postemergence control of goosegrass.

**Halosulfuron (Manage)**

**General:** Control of yellow and purple nutsedge, and suppression of *Kyllinga* spp.

**Tolerant Turfgrasses:** All cool- and warm-season grasses are tolerant to halosulfuron applications.

**Use Pattern:** Halosulfuron is used predominately for the control of sedges (*Cyperus* spp.). Treatments are most effective when the sedge plants are between the 3 and 8 leaf stages. Repeat applications, 6 to 10 weeks apart, are often required to control dense infestations. However, no more than 4 applications (total of 5.33 oz./acre) are recommended per acre per season.
Halosulfuron may be applied to turfgrasses that are well established, with the exception of putting greens. However, sprigging, seeding, or sodding into treated areas should be delayed for 4 weeks after halosulfuron applications.

**Overseeding Restriction:** Overseeding with ryegrass or bermudagrass can be conducted two weeks after application.

**Application Rate:** Halosulfuron is applied at 0.66 to 1.33 oz/acre. A nonionic surfactant should be added to reach a concentration of 0.25 or 0.5% v/v (1 to 2 qt. per 100 gal.). Halosulfuron is rainfast after 3 hours, but best results have been observed when no rainfall or irrigation occurs within 4 hours of application.

**Weeds Controlled.** Control of green kyllinga, yellow and purple nutsedge with halosulfuron can vary between 80 and 100%, depending on weed size and age at the time of application. For this reason, repeat applications occurring 6 to 10 weeks after the initial application may be necessary to increase control. Purple nutsedge is generally considered to be more sensitive to halosulfuron than yellow nutsedge.

**Metsulfuron (Manor)**

**General Use:** Control of ‘Pensacola’ bahiagrass, ryegrass, and numerous broadleaf weed species in turfgrass.

**Tolerant Turfgrasses:** Kentucky bluegrass, fine fescue, bermudagrass, St. Augustinegrass, zoysiagrass and centipedegrass are labeled for metsulfuron applications.

**Use Pattern:** Metsulfuron may be applied to tolerant turfgrasses, including golf course fairways, tees, aprons, and roughs, that are greater than 1 year old. However, applications made to tolerant cool-season turfgrass species when air temperatures are in excess of 85°F may increase injury.
**Overseeding Restriction:** Winter overseeding must be postponed for 2 months after application.

**Application Rate:** Metsulfuron is applied from 0.125 to 1 oz/acre in combination with a nonionic surfactant at 0.25% v/v (1qt per 100 gal). For fine fescue, Kentucky bluegrass and centipedegrass metsulfuron is used at rates of 0.25 to 0.5 oz/acre. Chlorosis and stunting are commonly occurs following application to centipedegrass.

St. Augustinegrass, bermudagrass, and zoysiagrass can tolerate metsulfuron application rates up to 1 oz/acre. Some chlorosis and stunting may occur after application and injury is worsened when the turfgrass is stressed from drought, cold temperatures, or poor fertility. Metsulfuron is an excellent alternative to phenoxy herbicides for broadleaf weed control in St. Augustinegrass.

**Weeds Controlled:** Metsulfuron will provide >90% control of ryegrass, common chickweed, white clover, dandelion, and wild garlic. To control henbit and ‘Pensacola’ bahiagrass at levels >70 to 80%, repeat applications at 4 to 6 week intervals are generally required.

**Rimsulfuron (Tranxit)**

**General Use:** Control of annual bluegrass in advance of overseeding bermudagrass and in nonoverseeded warm-season turfgrasses. Rimsulfuron may also be used as a spring transition aid in overseeded bermudagrass.

**Tolerant Turfgrasses:** Bermudagrass (fairway and putting green cultivars), zoysiagrass and centipedegrass.

**Use Pattern:** Rimsulfuron may be applied on sod farms, professional sports fields, and golf courses (fairways, greens, and tees). However, slight yellowing and growth
regulating effects have been observed for up to 7 days when rimsulfuron is applied to
‘Tifway’ bermudagrass. Rimsulfuron is not labeled for use on residential lawns.

Rimsulfuron is absorbed by both plant roots and foliage. Therefore, irrigation 1 hour
after application will move the herbicide into the soil and further increase herbicidal
effectiveness. Relying on natural rainfall to incorporate the herbicide is unreliable.
When applying irrigation, care must be used to prevent surface runoff as rimsulfuron can
move laterally with water in some situations. Short, frequent, irrigation cycles are most
effective to incorporate rimsulfuron without producing runoff.

Extreme caution must be exercised when applying rimsulfuron near, or on slopes that
drain onto, cool-season grasses. Spray drift, tracking, or runoff water may cause
excessive damage to creeping bentgrass greens or overseeded areas. Although tracking
and runoff seldom result in death of bentgrass, off-color and growth reduction can persist
for 14 days, or longer, depending on weather and fertility.

**Overseeding Restriction:** Overseeding with cool-season turfgrasses should be delayed
for 10 to 14 days after herbicide application.

**Application Rate:** Rimsulfuron may be applied at 0.5 to 2 oz./acre with a nonionic
surfactant at 0.25% v/v (1 qt per 100 gal). Applications of 0.5 to 1 oz./acre may be
applied to bermudagrass putting greens for overseeding removal; 1 to 2 oz./acre can be
applied to other bermudagrass areas. Repeat applications, occurring 3 weeks apart, are
commonly required for complete removal of *Poa trivialis*. For control of *Poa annua* in
bermudagrass putting greens prior to overseeding, the 1 to 2 oz./acre rate may be used
without the addition of surfactant.
**Weeds Controlled:** Rimsulfuron provides >90% control of several grass species, including ryegrass, fescue, and *Poa annua*, and broadleaf species such as common chickweed and spotted spurge. For large infestations of *Poa trivialis*, repeat applications are often more effective than a single application at a higher rate.

**Sulfosulfuron (Battalion) – (Registration Pending)**

**General:** Sulfosulfuron is currently being developed by Monsanto for sedge and annual bluegrass control in certain warm- and cool-season turfgrasses.

**Tolerant Turfgrasses:** Bermudagrass has been shown to be highly tolerant to sulfosulfuron. Although zoysiagrass, centipedegrass, ryegrass and creeping bentgrass are also tolerant, discoloration and growth regulation commonly occur after application. Tall fescue and St. Augustinegrass are not tolerant to sulfosulfuron.

**Overseeding Restriction:** The time interval from application time to overseeding is rate and turfgrass species dependent, and being investigated at this time.

**Use Pattern:** Sulfosulfuron has demonstrated excellent control of various members of the sedge family when applied during the summer months.

**Application Rate:** Sulfosulfuron at rates of 0.67 to 1.33 ozs./acre have shown excellent control of sedges. Various rate ranges are being evaluated for use in creeping bentgrass and for spring transition of overseeded bermudagrass.

**Weeds Controlled:** In turfgrasses, sulfosulfuron has primarily demonstrated activity for sedge control, and as a spring transition aid in overseeded bermudagrass. This herbicide is also being evaluated for *Poa trivialis* removal in creeping bentgrass fairways.
Trifloxysulfuron (Monument)

**General Use:** Trifloxysulfuron will be used for broadleaf weed, sedge and annual bluegrass control in bermudagrass and zoysiagrass.

**Tolerant Turfgrasses:** Bermudagrass and zoysiagrass are tolerant to trifloxysulfuron. However, a reduction in leaf elongation and suppression of seedheads has been observed in bermudagrass and zoysiagrass species. Other turfgrass species have not shown acceptable tolerance to trifloxysulfuron.

**Overseeding Restriction:** Overseeding should be delayed for 6 weeks after herbicide application.

**Use Pattern:** Trifloxysulfuron may be applied on golf courses, sod farms and other non-residential sites. Do not apply trifloxysulfuron to putting greens. On newly established turfgrasses trifloxysulfuron applications should be delayed until 100% ground cover, and a 2 inch root depth is achieved.

Trifloxysulfuron may be applied to control *Poa annua* and sedges, or as a transition aid for removing overseeded ryegrass. Bermudagrass and zoysiagrass can be sprigged or seeded 4 weeks after herbicide application. Trifloxysulfuron is currently not recommended for use on residential lawns.

**Application Rate:** Trifloxysulfuron may be applied between 0.1 and 0.56 oz/acre with 0.25 or 0.5% v/v (1 or 2 qt per 100 gal) nonionic surfactant. Application rates between 0.1 and 0.3 oz/acre are used when removing overseeded ryegrass and *Poa trivialis*; the lower use rate allows for slower transition. Delayed bermudagrass green-up has been observed when applications were made during dormancy. For *Poa annua* and sedge control, the 0.3 to 0.56 oz/acre application rates are recommended.
Repeat applications are often needed, 4 to 6 weeks after application, for control of particularly troublesome weeds such as sedges and tall fescue. However, a total of 1.7 oz/acre should not be exceeded within 1 year. Trifloxysulfuron is rainfast within 3 hours of application.

**Weeds Controlled:** Greater than 90% control has been observed of ryegrass, fescue, corn speedwell, Virginia buttonweed and sedges. Repeat applications after 4 to 6 weeks may be necessary depending on environmental conditions and weed size at time of application. Trifloxysulfuron will also provide some suppression of crabgrass, dallisgrass and bahiagrass. MSMA may be added to trifloxysulfuron in order to improve control of these particular grasses.

**Summary**

Sulfonylurea herbicides are, and will continue to be, highly useful herbicides in turfgrasses. Although no single herbicide has been developed to control all troublesome weeds such as sedges, *Poa annua*, “clump” tall fescue and “rogue” perennial ryegrass, proper selection of the appropriate SU herbicide will enable turfgrass managers to effectively control these weeds. Additionally, many SU herbicides can be used as a spring transition aid to remove perennial ryegrass and *Poa trivialis* from bermudagrass overseeded the previous fall. The SU herbicides offer turfgrass managers new solutions to many difficult weed management problems, and rotational alternatives to presently used herbicides. However, a word of caution is needed. All of the SU herbicides have the same mode-of-action, i.e. they inhibit the ALS enzyme (acetolactate synthase) which is involved in the production of three essential amino acids. Certain weed species have naturally-occurring biotypes that are resistant to ALS-inhibiting inhibitors such as the
sulfonylurea urea herbicides. Continued use of SU herbicides over a period of years, while not rotating to herbicides with a different mechanisms-of-action, can lead to the development of SU-resistant weeds. This has occurred in agronomic crops, and in roadside turfgrasses, where SU herbicides were not properly rotated. SUs are highly useful and effective herbicides. But, it will be imperative that SU’s be used in rotation with other herbicides to prevent the development of SU-resistant weeds. This is highly effective and exciting herbicide family, but, do not forget a basic principle of weed management, “rotate the use of herbicides with different mechanisms-of-action to prevent the buildup of herbicide-resistant weed populations”. If we follow this principle, turfgrass managers will have highly effective postemergence herbicides to control numerous problem weeds in turfgrasses for many years to come.
Table 1. Tolerance of warm- and cool-season grasses to sulfonylurea herbicides.

<table>
<thead>
<tr>
<th></th>
<th>St. Augustinegrass</th>
<th>Bermudagrass</th>
<th>Centipedegrass</th>
<th>Zoysiagrass</th>
<th>Perennial Ryegrass</th>
<th>Bentgrass</th>
<th>Tall Fescue</th>
<th>Kentucky Bluegrass</th>
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<tbody>
<tr>
<td>Chlorsulfuron</td>
<td>I</td>
<td>T</td>
<td>I</td>
<td>I</td>
<td>S</td>
<td>T^</td>
<td>S</td>
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</tr>
<tr>
<td>Flazasulfuron</td>
<td>S-I</td>
<td>T^</td>
<td>I-T</td>
<td>T</td>
<td>S</td>
<td>S</td>
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<td>S</td>
</tr>
<tr>
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<td>T</td>
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<tr>
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<td>T</td>
<td>I-T</td>
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<tr>
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<td>T</td>
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</tr>
</tbody>
</table>

^T=tolerant, I=intermediate tolerance, S=sensitive

^1Fine Fescue is tolerant to chlorsulfuron applications.

^2Bentgrass must be mowed at a height >0.5 inches.

^3Many bermudagrasses have high tolerance to flazasulfuron, but ‘Floradwarf’ has shown low to moderate tolerance.

Table 2. Weed control with sulfonylurea herbicides.
<table>
<thead>
<tr>
<th></th>
<th>chlor-sulfuron</th>
<th>flaza-sulfuron</th>
<th>foramsulfuron</th>
<th>halo-sulfuron</th>
<th>met-sulfuron</th>
<th>rim-sulfuron</th>
<th>sulfo-sulfuron</th>
<th>trifloxy-sulfuron</th>
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<td><strong>Grass Weeds</strong></td>
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<td>bluegrass, annual</td>
<td>P</td>
<td>P-G</td>
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<td>P</td>
<td>P</td>
<td>E</td>
<td>P-F</td>
<td>G-E</td>
</tr>
<tr>
<td>crabgrass spp.</td>
<td>P</td>
<td>F-E</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P-F</td>
<td>P-F</td>
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<td>E</td>
<td>E</td>
<td>P</td>
<td>P-F</td>
<td>E</td>
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<td>P</td>
<td>G-E</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
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<td>E</td>
<td>E</td>
<td>P</td>
<td>F</td>
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<tr>
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<td>E</td>
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<td>P</td>
<td>F-G</td>
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<td><strong>Broadleaf Weeds</strong></td>
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<td>P-F</td>
<td>G</td>
<td>P</td>
<td>F</td>
<td>G</td>
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<td>P</td>
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<td>G-E</td>
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<td>P</td>
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<td>corn speedwell</td>
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<td>P</td>
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<td>G</td>
<td>P</td>
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<tr>
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<td>F</td>
<td>G</td>
<td>P</td>
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<tr>
<td><strong>Other Weeds</strong></td>
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<td>G-E</td>
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<td>F</td>
<td>E</td>
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<tr>
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<td>P</td>
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<td>G-E</td>
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</tbody>
</table>

E = >90%  F = 70-80%

G = 80-90%  P = <70%
A blank space indicates that weed response is not known.

These data were compiled from the annual weed science research reports of Shawn Askew at Virginia Tech, John Boyd at the University of Arkansas, Bert McCarty at Clemson University, Tim Murphy at the University of Georgia, Brian Unruh and Barry Brecke at the University of Florida, and Fred Yelverton at N.C. State University.