

SUGARCANE WEED MANAGEMENT

The Sugarcane Weed Management Guide is prepared by Dr. Al Orgeron, Area Pest Management Specialist, LSU AgCenter, Hammond, La, and Dr. Douglas Spaunhorst, USDA-ARS, Sugar Research Unit, Houma, La. The sections in the guide are in chronological order based on the sugarcane growing season from planting through harvest. Also included are sections on fallow and ditchbank weed control. For additional information concerning herbicides listed in this weed guide, consult the herbicide label. Expected weed control with sugarcane herbicides is provided in Table 1. A listing of various herbicides by common name and trade name is included in Table 2. Table 3 is a listing of herbicides registered for use on ditchbanks. Provided in Table 4 is a listing of glyphosate products with surfactant recommendations. Information related to weed management programs for crops grown in Louisiana can be found at https://www.lsuagcenter.com/portals/communications/publications/management_guides. Follow the link for the Suggested Weed Chemical Control Guide for the most current information.

Rates for herbicides are expressed on a broadcast basis. To calculate band rate, for liquid and dry formulations, use this formula:

$$\frac{\text{Band width in inches}}{\text{Row width in inches}} \times \text{Broadcast RATE per acre} = \text{Band RATE per acre}$$

AT-PLANTING WEED CONTROL (AUGUST/SEPTEMBER)

Herbicides may be applied on a band to the top of the row or broadcast. A broadcast application will help reduce weed encroachment from the row middles. Herbicide should be applied immediately after the row has been rolled or packed. When rainfall of about one half-inch is received within 10 days after herbicide application, residual weed control can be expected for about 60 days. A follow-up herbicide application about 60 days after planting can extend the control of summer weeds and also can provide residual control of winter weeds, resulting in cleaner beds in spring. See "At-Planting Preemergence Split Application Programs" and "Postemergence Weed Control (September-November)" sections. Herbicide programs described in this section also can be used in sugarcane harvested for seed and in sugarcane harvested early during grinding.

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled (See Table 1)	Remarks and Precautions
AT-PLANTING PREEMERGENCE (AUGUST/SEPTEMBER):			
atrazine @ 2.0 - 4.0 lb/A	Atrazine/others (See Table 2) 4L @ 2.0 – 4.0 qt/A 90DF @ 2.2 - 4.4 lb/A	Annual summer and winter broadleaf weeds	Use higher rate on heavy soils and when sugarcane is planted prior to early September.
sulfentrazone plus metribuzin @ 0.18 - 0.37 lb/A + 0.27 - 0.56 lb/A	Authority MTZ 45DF @ 16 - 33 oz/A	Morningglory (tie-vine), divine nightshade, and other broadleaf weeds and nutsedge	Use higher rate on heavy soils and soils with organic matter higher than 2 percent. At the highest rate of 33 oz/A the amount of metribuzin in Authority MTZ is not sufficient to provide grass control. A 16 oz rate of Authority MTZ contains 0.27 lb of metribuzin; A 33 oz rate of Authority MTZ contains 0.56- lb of metribuzin.
mesotrione @ 0.19 - 0.24 lb/A	Callisto 4L/others @ 6 - 7.7 oz/A	Annual summer and winter broadleaf weeds	Use higher rate on heavy soils or when sugarcane is planted prior to early September.
clomazone @ 1.0 - 1.25 lb/A plus diuron @ 2.5 lb/A	Command 3ME @ 2.7 - 3.3 pt/A plus Diuron/Direx/others (See Table 2) 4L at 2.5 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses; bermudagrass suppression	Use higher rate on heavy soils and when sugarcane is planted prior to early September. Bleaching can occur when sugarcane has less than 2 inches of soil cover.
clomazone @ 1.0 - 1.25 lb/A plus metribuzin @ 0.75 lb/A	Command 3ME @ 2.7 - 3.3 pt/A plus Metribuzin/others (See Table 2) 75DF @ 1.0 lb/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses; bermudagrass suppression	Use higher rate on heavy soils and when sugarcane is planted prior to early September. Bleaching can

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Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled (See Table 1)	Remarks and Precautions
AT-PLANTING PREEMERGENCE (AUGUST/SEPTEMBER):			
			occur when sugarcane has less than 2 inches of soil cover.
diuron @ 2.4 - 3.0 lb/A	Diuron/Direx /others (See Table 2) 4L @ 2.4 – 3.0 qt/A 80DF @ 3.0 - 3.8 lb/A	Broadleaf weeds	Use higher rate on heavy soils and when sugarcane is planted prior to early September.
metribuzin @ 1.5 - 3.0 lb/A	Metribuzin /others (See Table 2) 75DF @ 2.0 - 4.0 lb/A	Seedling johnsongrass and other annual grasses and broadleaf weeds	Safe to sugarcane on all soil types. Use higher rate on heavy soils and when sugarcane is planted prior to early September. Can provide bermudagrass suppression at higher rates. Addition of pendimethalin can improve control of browntop millet and itchgrass.
S-metolachlor @ 1.71 - 2.33 lb/A plus atrazine @ 0.64 - 0.88 lb/A mesotrione @ 0.71 – 0.23 lb/A	Lumax EZ 3.7 L @ 2.75 – 3.75 qt/A	Browntop millet, other annual grasses, morningglory (tie-vine), divine nightshade, and other broadleaf weeds; yellow nutsedge and seedling johnsongrass suppression	Use the higher rate on heavier soils, soils with higher organic matter content, and when sugarcane is planted prior to early September. When applied alone, Lumax EZ poorly controlled itchgrass; however, the addition of clomazone or pendimethalin can improve control of johnsongrass and itchgrass.
pendimethalin @ 2.0 - 3.0 lb/A	Prowl/Prowl H₂O /others (See Table 2) 3.3EC @ 2.4 - 3.6 qt/A 3.5EW @ 2.25 - 3.4 qt/A 3.8CS @ 2.1 - 3.1 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses	May be applied to the soil surface or incorporated. Use higher rate on heavy soils. Should be applied with other herbicides for broadleaf weed control. Addition of metribuzin can improve control of bermudagrass.
terbacil @ 0.8 - 1.2 lb/A	Sinbar 80WDG @ 1.0 - 1.5 lb/A (1.0 lb/A on very sandy soils)	Seedling johnsongrass and other grass and broadleaf weeds; bermudagrass suppression	Use higher rate on heavy soils and when sugarcane is planted prior to early September. Addition of pendimethalin can improve control of browntop millet and itchgrass.
Pendimethalin @ 1.99 – 2.90 lb/A plus metribuzin @ 0.76 -1.1 lb/A	Tripzin ZC @ 2.75 - 4 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses and broadleaf weeds	Use higher rate on heavy soils.
sulfentrazone @ 0.31 - 0.38 lb/A	Spartan 4F/others @ 10.0 - 12.0 oz/A	Divine nightshade, broadleaf weeds and nutsedge	Use higher rate on heavy soils and when sugarcane is planted prior to early September. Poor control of smallflower morningglory.
sulfentrazone @ 0.31 - 0.38 lb/A plus carfentrazone-ethyl @ 0.035 - 0.041 lb/A	Spartan Charge 3.5 SE @ 12.8 - 15.2 oz/A	Divine nightshade, broadleaf weeds and nutsedge	Use higher rate on heavy soils and when sugarcane is planted prior to early September. Poor control of smallflower morningglory.
trifluralin @ 1.0 - 2.0 lb/A	Treflan/Trifluralin /others (See Table 2) 4L @ 1.0 - 2.0 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses; bermudagrass suppression	Roll or pack rows and incorporate herbicide within 24 hours after application. Avoid incorporation at a depth that will damage seed pieces. Other herbicides

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Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled (See Table 1)	Remarks and Precautions
AT-PLANTING PREEMERGENCE (AUGUST/SEPTEMBER):			
			should be applied to the soil surface for broadleaf weed control.
flumioxazin @ 0.19 - 0.25 lb/A	Valor SX 51WDG @ 6.0 - 8.0 oz/A	Divine nightshade and annual broadleaf weeds	Use higher rate on heavy soils or when sugarcane is planted prior to early September. Do not apply after sugarcane emergence.
hexazinone @ 0.5 lb/A plus diuron @ 2.5 lb/A	Velpar 2L @ 1.0 qt/A or Velossa 2.4L @ 1.6 pt/A plus Diuron/Direx /others (See Table 2) 4L at 2.5 qt/A	Seedling johnsongrass, browntop millet and other annual grass and broadleaf weeds; bermudagrass suppression	Apply before sugarcane emerges. Application to coarse-textured soils that are low in organic matter may result in sugarcane chlorosis (yellowing) and stunting.
hexazinone @ 0.5 lb/A plus metribuzin @ 1.5 lb/A	Velpar 2L at 1.0 qt/A or Velossa 2.4L @ 1.6 pt/A plus Metribuzin /others (See Table 2) 75DF @ 2.0 lb/A	Seedling johnsongrass, browntop millet and other annual grass and broadleaf weeds; bermudagrass suppression	Apply before sugarcane emerges. Application to coarse-textured soils that are low in organic matter may result in sugarcane chlorosis (yellowing) and stunting.

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AT-PLANTING PREEMERGENCE SPLIT APPLICATION PROGRAMS

A split application program with herbicide applied at planting and around 60 days later will provide extended residual control of bermudagrass, johnsongrass and itchgrass. In some cases where split application programs are used, beds in the spring are essentially free of winter weeds. Programs that can be successful in suppressing bermudagrass include:

Command at 3.3 pt/A plus **Diuron/Direx**/others at 2.5 qt/A at planting followed 60 days later by **Metribuzin**/others at 1.5 lb/A

Command at 3.3 pt/A plus **Metribuzin**/others at 1.0 lb/A at planting followed 60 days later by **Metribuzin**/others at 1.5 lb/A

Metribuzin/others at 2 to 3 lb/A at planting followed 60 days later by **Metribuzin**/others at 1.5 lb/A

Velpar at 1 qt/A or **Velossa** at 1.6 pt/A plus **Diuron/Direx**/others at 2.5 qt/A at planting followed 60 days later by **Metribuzin**/others at 1.5 lb/A

Velpar at 1 qt/A or **Velossa** at 1.6 pt/A plus **Metribuzin**/others at 1.0 lb/A at planting followed 60 days later by **Metribuzin**/others at 1.5 lb/A

Treflan/Trifluralin/others at 1.5 to 2 qt/A and incorporated at planting followed 60 days later by **Metribuzin**/others at 1.5 lb/A

Another option for bermudagrass would be to apply herbicide at planting on a band and sink the middles prior to the follow-up application. This program will reduce cost up front but will require an additional tillage operation and favorable weather conditions. If tillage cannot be performed, encroachment of bermudagrass from the row middles can result in a severe weed problem the following year.

WEED CONTROL IN SUGARCANE HARVESTED FOR SEED AND IN SUCCESSION PLANTED SUGARCANE

Although shading from the crop canopy will suppress growth of weeds, once sugarcane is harvested for seed, bermudagrass will rapidly initiate new growth. Any of the herbicide programs listed for use at planting can also be used in fields where sugarcane was harvested for seed or where sugarcane was harvested early and delivered to the mill. Herbicides listed for use at planting may also be used when sugarcane is succession planted. Rates may be reduced slightly (25 percent) due to the later planting date and to minimize the chance of sugarcane injury.

RESIDUAL CONTROL OF WINTER WEEDS (OCTOBER/NOVEMBER)

For residual control of winter grass and broadleaf weeds apply **Lumax EZ**, **Atrazine**/others, **Diuron/Direx**/others, **Velpar** plus **Diuron/Direx**/others, **Metribuzin**/others, or **Sinbar** in October/November to early harvested sugarcane, newly planted sugarcane, or sugarcane harvested for seed. Herbicide rates specified in the "At-Planting Weed Control (August/September)" section can be reduced by 25 percent for November applications. Where a follow-up application is being made, selecting a herbicide other than the one previously applied should be considered to reduce risk of crop injury and development of herbicide resistant weeds. If weeds are present, nonionic surfactant at 1 to 2 qt/100 gal or crop oil concentrate at 2 to 4 qt/100 gal should be added to the spray solution.

POSTEMERGENCE WEED CONTROL (SEPTEMBER-NOVEMBER)

Johnsongrass and Itchgrass (September/October): In early planted sugarcane or in sugarcane harvested for seed, johnsongrass may reinfest fields prior to winter. When applied in October to actively growing johnsongrass 12 to 18 inches tall, **Asulox/Asulam** 3.3L at 3 qt/A or **Envoke** 75WG at 0.2 oz/A plus **Asulox/Asulam** (See Table 2 Glossary of Herbicides) at 2 qt/A plus nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 4 qt/100 gal of water has controlled johnsongrass and reduced reinfestation the following spring. **Asulox/Asulam** alone and with **Envoke** also controls large itchgrass (more than 6 inches). For additional information on **Asulox/Asulam** and **Envoke** see the "Postemergence Weed Control - Johnsongrass and Other Grasses (March/April)" section.

Purple and Yellow Nutsedge (September/October): To control purple and yellow nutsedge 4 to 12 inches in height in early planted sugarcane apply **Permit**/others 75WDG (See Table 2 Glossary of Herbicides) at 1.0 to 1.33 oz/A with nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 4 qt/100 gal of water. To control 2 to 6 inch yellow nutsedge or to suppress 2 to 4 inch purple nutsedge, apply **Envoke** 75 WG at 0.2 oz/A with nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 4 qt/100 gal of water. The higher rate of Permit/others is needed when nutsedge is large and the population is dense. For best results herbicide application should be made before nutsedge is 6 inches tall. If application is delayed until nutsedge forms a dense mat on the soil surface a sizeable tuber population will have developed underground and control will be reduced. Activity of both Permit/others and Envoke is slow and four weeks may be needed to maximize control. Sugarcane is very tolerant to overtop application of Permit/others. No more than three applications of Permit/others can be made per year and no more than 2.33 oz should be applied per acre per year. Envoke can cause some yellowing and white banding on sugarcane leaves as well as slight stunting but sugarcane growth and emergence in spring has not been affected. Envoke

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will also provide some residual control of winter weeds. Other herbicides may be applied with Permit/others or Envoke for additional weed control. *For additional information on Permit/others and Envoke see the "Postemergence Weed Control - Purple and Yellow Nutsedge (March/April)" section.*

Yukon, a 67.5 percent WDG premix of halosulfuron (the active ingredient in Permit/others) and dicamba (the active ingredient in Clarity/Vision), can provide control of both nutsedge and broadleaf weeds. For Yukon, a 4 oz/A rate is equivalent to 0.67 oz/A Permit 75 WDG and 4.5 oz/A Clarity/Vision 4L; a 6 oz/A rate is equivalent to 1 oz/A Permit and 6.6 oz/A Clarity/Vision; and a 8 oz/A rate is equivalent to 1.3 oz/A Permit and 9.0 oz/A Clarity/Vision.

Bermudagrass (September-November): Shielded application of **glyphosate** to row sides and middles after planting or early harvest has provided good to excellent control of emerged bermudagrass (See Table 4 Glyphosate Products). Apply 2 to 3 qt/A of the 4 lb ai/gallon formulation or equivalent rate based on active ingredient in 5 to 20 gal of water per acre as a shielded application. *Information on glyphosate can be found in the "Fallow Weed Control" section.* Severe injury will occur if glyphosate comes in contact with sugarcane foliage.

Armezon (September-November): In early planted sugarcane or in sugarcane harvested for seed, bermudagrass may infest fields prior to winter. When applied to actively growing bermudagrass, Armezon 2.8 SC at 1 to 2 oz/A plus methylated seed oil or crop oil concentrate at 4 qt/100 gal of water plus approved nitrogen fertilizers has shown to suppress bermudagrass and may result in fewer bermudagrass stolons in spring.

Broadleaf Weeds (September-November): Apply **Weedmaster/Brash/others** 3.8L at 0.5 to 1 qt/A, **2,4-D** 3.8L at 0.5 to 1.5 qt/A, **Unison** 1.74L at 24 to 64 oz/A, **Clarity/Vision/others** 4L at 0.5 to 1.0 pt/A, or **Engenia** 5L at 6.4 to 12.8 oz/A when air temperature is above 65° F (See Table 2 Glossary of Herbicides). *Additional information related to these herbicides is provided in the "After Layby Weed Control (July-Harvest)" section.*

2,4-D Formulations: Acid, amine salt and ester formulations of **2,4-D** are available (See Table 2 Glossary of Herbicides). Since only the acid form of 2,4-D is active in controlling weeds, the herbicide concentration on the label is provided in lb of ae (acid equivalent) per gal instead of lb of ai (active ingredient) per gal, as is the case with most other herbicides. Amine salt and ester formulations of 2,4-D range from 3.8 to 5.6 lb ae/gal. These numbers are important in determining the amount of formulated product to apply per acre. The lower the lb ae/gal the more formulated product required. For example, a 32 fluid oz rate (1 qt/A) of a 3.8L formulation would correspond to 21.7 oz for a 5.6L formulation. **Unison** is an acid formulation of 2,4-D and contains 1.74 lb ae/gal. The rate range for Unison is 24 to 64 oz/A and rate, like other formulations, is dependent on weed spectrum, density and size. Unison is less volatile (susceptible to changing from a liquid to a gas where off-target movement can occur) than other 2,4-D formulations. Caution should be used anytime 2,4-D is applied near sensitive plants regardless of formulation.

POSTEMERGENCE WEED CONTROL WINTER WEED CONTROL (JANUARY-MARCH)

Broadleaf Weeds: Apply **Weedmaster/Brash/others** 3.8L at 0.5 to 1.0 qt/A, **2,4-D** 3.8L at 0.5 to 1.5 qt/A, **Unison** 1.74L at 24 to 64 oz/A, **Clarity/Vision/others** 4L at 0.5 to 1.0 pt/A, or **Engenia** 5L at 6.4 to 12.8 oz/A after broadleaf weeds have emerged and when air temperature is above 65° F (See Table 2 Glossary of Herbicides). The higher rate should be used when broadleaf weeds are large and clover or vetch is present. *Information related to these herbicides and 2,4-D formulations is provided in the "After Layby Weed Control (July-Harvest)" section.* **Atrazine/others**, **Diuron/Direx/others**, **Velpar** plus **Diuron/Direx/others**, **Metribuzin/others**, or **Valor** (prior to sugarcane emergence) may be added to improve postemergence weed control and to provide soil residual activity.

Grass and Broadleaf Weeds: **Gramoxone SL** 2L at 3 pt/A or **Paraquat/others** 3L (See Table 2 Glossary of Herbicides) at 2 pt/A plus nonionic surfactant at 1 to 2 qt/100 gal or crop oil concentrate at 2 to 4 qt/100 gal can be applied to sugarcane with no more than 4 leaves to control ryegrass, rescuegrass, timothy grass, and winter annual bluegrass as well as some broadleaf weeds. **Atrazine/others**, **Diuron/Direx/others**, **Velpar** plus **Diuron/Direx/others**, **Metribuzin/others**, or **Valor** (prior to sugarcane emergence) may be added to improve burndown and provide soil residual activity. **Gramoxone SL/Paraquat/others** can also be applied with **Weedmaster/Brash/others**, **2,4-D**, or **Clarity/Vision/others**. Annual bluegrass can be controlled with **Diuron/Direx/others** 4L at 2.5 lb/A, **Velpar** 2L at 0.8 qt/A plus **Diuron/Direx/others** 4L at 1.4 qt/A, **Metribuzin/others** at 1.33 lb/A, or **Sinbar** at 1.25 lb/A plus a nonionic surfactant or crop oil concentrate. If herbicides with soil residual activity are applied prior to March 1, schedule layby cultivation and herbicide application earlier than normal to avoid weed reinfestation. Selection of a herbicide other than the one previously applied should be considered to reduce risk of crop injury and development of herbicide resistant weeds.

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SPRING WEED CONTROL (FEBRUARY/MARCH)

Herbicide programs should be implemented in February or March after residue from the previous harvest has been removed. If weeds are present, nonionic surfactant at 1 to 2 qt/100 gal or crop oil concentrate at 2 to 4 qt/100 gal should be added to the spray solution. In most cases herbicide is banded on the top of the row following cultivation of the row sides and middles. If winter broadleaf weeds are present **Weedmaster/Brash**/others 3.8L at 0.5 to 1.0 qt/A, **2,4-D** 3.8L at 0.5 to 1.5 qt/A, **Unison** 1.74L at 24 to 64 oz/A, or **Clarity/Vision**/others 4L at 0.5 to 1.0 pt/A can be added (See Table 2 Glossary of Herbicides). The higher rate should be used when broadleaf weeds are large and clover or vetch is present.

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
PREEMERGENCE (FEBRUARY/MARCH):			
atrazine @ 2.0 - 4.0 lb/A	Atrazine /others (See Table 2) 4L @ 2 - 4 qt/A 90DF @ 2.2 - 4.4 lb/A	Seedling broadleaf weeds	Use higher rate on heavy soils.
mesotrione @ 0.09lb/A	Callisto 4L/others @ 3 oz/A	Seedling broadleaf weeds	Addition of atrazine can improve broadleaf weed control.
mesotrione @ 0.08 - 0.09 lb/A plus atrazine @ 0.5 – 0.6 lb/A	Callisto Xtra @ 20 - 24 oz/A	Seedling broadleaf weeds	Use higher rate on heavy soils.
clomazone @ 1.0 - 1.25 lb/A plus diuron @ 2.5 lb/A	Command 3ME @ 2.7 - 3.3 pt/A plus Diuron/Direx /others (See Table 2) 4L at 2.5 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses; bermudagrass suppression	Bleaching/whitening of sugarcane can occur if the crop is emerged at application.
clomazone @ 1.0 - 1.25 lb/A plus metribuzin @ 0.75 lb/A	Command 3ME @ 2.7 - 3.3 pt/A plus Metribuzin /others (See Table 2) 75DF @ 1.0 lb/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses; bermudagrass suppression	Bleaching/whitening of sugarcane can occur if the crop is emerged at application.
diuron @ 2.4 - 3.0 lb/A	Diuron/Direx /others (See Table 2) 4L @ 2.4 - 3.0 qt/A 80DF @ 3.0 - 3.8 lb/A	Seedling broadleaf weeds	Use higher rate on heavy soils. Application can be applied overtop of sugarcane until daily maximum temperatures for the week preceding application average 80 degrees F or greater.
S-metolachlor @ 0.93 – 1.87 lb/A plus atrazine @ 0.35 - 0.70 lb/A mesotrione @ 0.09 – 0.19 lb/A	Lumax EZ 3.7 L @ 1.5 – 3.0 qt/A	Browntop millet, other annual grasses, morningglory (tie-vine), divine nightshade and other broadleaf weeds; yellow nutsedge and seedling johnsongrass suppression	Use higher rate on heavy soils. Addition of pendimethalin can improve control of johnsongrass and itchgrass. If applied at planting or in fall, the cumulative yearly amount of Lumax EZ cannot exceed 5.25 qt/A.
metribuzin @ 1.5 - 3.0 lb/A	Metribuzin /others (See Table 2) 75DF @ 2.0 - 4.0 lb/A	Seedling johnsongrass and other annual grass and broadleaf weeds	Safe to sugarcane on all soil types. Use higher rate on heavy soils. Can provide suppression of bermudagrass at higher rates. Addition of pendimethalin can improve control of browntop millet and itchgrass.
pendimethalin @ 2.0 - 3.0 lb/A	Prowl/Prowl H₂O /others (See Table 2) 3.3EC @ 2.4 - 3.6 qt/A 3.8CS @ 2.1 - 3.1 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses	May be applied to the soil surface or incorporated. Use higher rate on heavy soils. Should be applied with other herbicides for broadleaf weed control. Addition of metribuzin can improve control of bermudagrass.

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Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
PREEMERGENCE (FEBRUARY/MARCH):			
Pendimethalin @ 1.99 – 2.90 lb/A plus metribuzin @ 0.76 -1.1 lb/A	Tripzin ZC @ 2.75 - 4 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses and broadleaf weeds	Use higher rate on heavy soils.
trifluralin @ 2.0 lb/A	Treflan/Trifluralin/others (See Table 2) 4L @ 2.0 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses	Incorporate within 24 hours after application. Can provide suppression of bermudagrass. Other herbicides should be applied for broadleaf weed control.
flumioxazin @ 0.13 - 0.25 lb/A	Valor SX 51WDG @ 4.0 - 8.0 oz/A	Divine nightshade and annual broadleaf weeds	Can provide residual control when applied at 6 to 8 oz/A. Do not apply after sugarcane emergence.
hexazinone @ 0.5 lb/A plus diuron @ 2.5 lb/A	Velpar 2L @ 1.0 qt/A or Velossa 2.4L @ 1.6 pt/A plus Diuron/Direx/others (See Table 2) 4L at 2.5 qt/A	Seedling johnsongrass, browntop millet and other annual grass and broadleaf weeds; bermudagrass suppression	Apply to sugarcane before active tillering begins. Application to coarse-textured soils that are low in organic matter may result in sugarcane chlorosis (yellowing) and stunting.
hexazinone @ 0.5 lb/A plus metribuzin @ 1.5 lb/A	Velpar 2L at 1.0 qt/A or Velossa 2.4L @ 1.6 pt/A plus Metribuzin/others (See Table 2) 75DF @ 2.0 lb/A	Seedling johnsongrass, browntop millet and other annual grass and broadleaf weeds; bermudagrass suppression	Apply to sugarcane before active tillering begins. Application to coarse-textured soils that are low in organic matter may result in sugarcane chlorosis (yellowing) and stunting.

POSTEMERGENCE WEED CONTROL (MARCH/APRIL)

Johnsongrass and Other Grasses (March/April): **Asulox/Asulam** can be applied broadcast, banded, or as a spot treatment. Nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 1 gal/100 gal of water should be added to the spray solution. If the pH of water is above 9.0, addition of a buffer may be beneficial. At application, average air temperature should be at least 60°F. A 20-hour rain-free period following Asulox application may be needed to maximize control.

First Application - Apply 4 qt/A **Asulox/Asulam** 3.3L broadcast (or the correct proportion if applying on a band) in 15 to 30 gal of water per acre to actively growing johnsongrass 12 to 18 inches tall and to itchgrass less than 8 inches tall. If applying on a band, outside nozzles should be mounted on drops and band width should be wide enough to ensure thorough wetting of all foliage. Asulox applied at 3 to 4 qt/A also controls browntop millet, foxtails, goosegrass and barnyardgrass/junglerice when 6 to 8 inches tall. Vaseygrass that is less than 8 inches tall can be partially controlled with Asulox at 4 qt/A, but activity is very slow.

Second Application - A second application of **Asulox/Asulam** at 3 to 4 qt/A broadcast (or the correct proportion if applying on a band) can increase johnsongrass control, but may not increase sugarcane yield over that obtained with a single Asulox application in March/April. This may be beneficial in the plant cane or first stubble crop to reduce infestations in subsequent crops. The second application of Asulox should be made to johnsongrass regrowth, usually about eight weeks after the first application. Sugarcane injury is more likely when Asulox is applied to sugarcane stressed from drought or excessive soil moisture and high temperature, especially after June 1.

Spot Treatment - The most accurate and economical method of spot treating is to use a calibrated sprayer at a constant speed with the operator turning the spray nozzles on and off as needed. If a high-volume “cattle gun” type nozzle is used for spot treatment, apply a 2% solution of **Asulox/Asulam** (2 gal of herbicide plus 98 gal of water). Spray to wet foliage but do not drench as sugarcane injury can be greater compared with spot treating using a calibrated sprayer.

Aerial Application - **Asulox/Asulam** may also be applied by air using the same rates specified above. Spray volume should be a minimum of 5 gal per acre. After calculating the actual sugarcane acreage to be treated, acreage should be increased to account for ditchbanks and headlands also receiving application.

Envoke - **Envoke 75WG** can be applied postemergence overtop to plant or ratoon cane up to 24 inches tall at 0.3 oz/A broadcast (or the correct proportion if applying on a band) or as a directed application at 0.3 to 0.6 oz/A to sugarcane 18 inches tall at layby. Nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 4 qt/100 gal of water should be added to the spray solution. **Envoke** applied overtop of sugarcane can cause some yellowing and white banding on leaves present in the whorl at application.

SUGARCANE WEED MANAGEMENT

as well as slight stunting but recovery is rapid and no negative effect on sugarcane yield has been observed. Envoke at 0.3 oz/A will suppress but will not control rhizome johnsongrass or large itchgrass. Combinations of **Envoke** with **Asulox/Asulam** provide complementary broadleaf and grass weed control. Envoke at 0.3 oz/A applied with Asulox 3.3 L at 2 qt/A (half rate) plus nonionic surfactant or crop oil concentrate has improved control of large rhizome johnsongrass (more than 18 inches) when compared with Asulox applied alone at 4 qt/A (full rate). Envoke at 0.2 oz/A applied with Asulox at 2 qt/A controlled large itchgrass (more than 6 inches) better than Asulox applied alone at 4 qt/A. For ground application use a minimum of 10 gal of water per acre (broadcast basis). Higher spray volume of at least 20 gal per acre should be used for heavy weed infestations to ensure adequate spray coverage. **Envoke cannot be applied aerially. For both Asulox/Asulam and Envoke, DO NOT cultivate, fertilize or otherwise disturb the johnsongrass root system 7 days before or after application.**

Purple and Yellow Nutsedge (March/April): Apply **Permit**/others 75WDG at 1.0 to 1.33 oz/A, **Yukon** 67.5 WDG at 6 to 8 oz/A, or **Envoke** 75 WG at 0.2 oz/A with nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 1 gal/100 gal of water.

Divine Nightshade (March/April): **Clarity/Vision**/others 4L at 1.0 qt/A, **Callisto** 4L at 3 oz/A plus **Atrazine**/others at 2 qt/A, or **Callisto Xtra** at 24 oz/A plus **Atrazine**/others at 1.5 qt/A with nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 1 gal/100 gal of water will provide limited control of divine nightshade. EPA has granted a Section 18 Quarantine Emergency Exemption for use of **Trycera** to manage divine nightshade until May 31, 2020. **Trycera** may be applied from October 1 to May 31, in all commercial sugarcane parishes at 0.7 to 2.1 qt/A. Application is limited to ground rig application, and a minimum of 15 gallons per acre should be used. Addition of nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 1 gal/100 gal of water is recommended.

Bermudagrass (March/April): **Armezon** 2.8 SC at 1 to 2 oz/A plus methylated seed oil or crop oil concentrate at 4 qt/100 gal of water plus approved nitrogen fertilizers will provide three to five weeks of bermudagrass suppression. Sequential application may be applied 14 days after the initial treatment. **Armezon** can be tank-mixed with other herbicides registered in sugarcane such as **Atrazine**, **Metribuzin**, or **Prowl**. Applicators must follow label restrictions for the most restrictive tank-mix product. The maximum yearly use rate for **Armezon** is 4 oz/A. Research has shown reduced bermudagrass suppression when **Armezon** and **Metribuzin** were tank-mixed. Delay cultivation for two to three weeks following application.

LAYBY WEED CONTROL (MAY/JUNE)

Herbicides at layby are applied broadcast and directed underneath the sugarcane canopy usually following the last cultivation. It is necessary that the lower canopy be contacted by the spray to assure weed control both in the sugarcane drill and in the row middles. If weeds are present, nonionic surfactant at 1 to 2 qt/100 gal or crop oil concentrate at 2 to 4 qt/100 gal should be added to the spray solution for herbicides with postemergence activity. *Information related to postemergence activity of herbicides can be found in the "After Layby Weed Control (July-Harvest)" section.*

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
PREEMERGENCE LAYBY (MAY/JUNE):			
atrazine @ 2.0 - 4.0 lb/A	Atrazine /others (See Table 2) 4L @ 2 - 4 qt/A 90DF @ 2.2 - 4.4 lb/A	Morningglory (tie-vine) and other broadleaf weeds	Use higher rate on heavy soils and where morningglory (tie-vine) is a problem weed. Residual red morningglory control can be expected for around 35 days. Residual control of tie-vine can be extended by applying atrazine a few weeks after the layby cultivation.
sulfentrazone plus metribuzin @ 0.18 - 0.37 lb/A + 0.27 - 0.56 lb/A	Authority MTZ 45DF @ 16 - 33 oz/A	Morningglory (tie-vine), divine nightshade, and other broadleaf weeds and nutsedge	Use higher rate on clay soils and/or soils with organic matter content higher than 2%. At the highest rate of 33 oz/A the amount of metribuzin in Authority MTZ is not sufficient to provide grass control. See information below for Spartan 4F concerning red morningglory control. Injury will occur if

SUGARCANE WEED MANAGEMENT

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
PREEMERGENCE LAYBY (MAY/JUNE):			
			herbicide contacts newly emerging sugarcane shoots and leaves. Do not apply more than 33 oz/A in one growing season and within 120 days of harvest.
mesotrione @ 0.09 lb/A	Callisto 4L/other @ 3 oz/A	Morningglory (tie-vine) and other broadleaf weeds	Addition of atrazine can improve broadleaf weed control, as well as provide postemergence control of divine nightshade. Should be applied with other herbicides for grass control.
mesotrione @ 0.08 - 0.09 lb/A plus atrazine @ 0.5 - 0.6 lb/A	Callisto Xtra @ 20 - 24 oz/A	Morningglory (tie-vine) and other broadleaf weeds	Use higher rate on heavy soils. Should be applied with other herbicides for grass control. Addition of atrazine can improve postemergence control of divine nightshade.
diuron @ 2.4 - 3.0 lb/A	Diuron/Direx /others (See Table 2) 4 lb/gallon formulation @ 2.4 - 3 qt/A 80 DF formulation @ 3.0 - 3.8 lb/A	Seedling broadleaf weeds	Apply when sugarcane is 30 inches or taller. Injury will occur if herbicide contacts newly emerging sugarcane shoots and leaves.
S-metolachlor @ 0.93 – 1.87 lb/A plus atrazine @ 0.35 - 0.70 lb/A mesotrione @ 0.09 – 0.19 lb/A	Lumax EZ 3.7 L @ 1.5 – 3.0 qt/A	Browntop millet, other annual grasses, morningglory (tie-vine), divine nightshade and other broadleaf weeds; yellow nutsedge and seedling johnsongrass suppression	Use higher rate on heavy soils. Do not apply to sugarcane greater than 60 inches in height and within 100 days of harvest. Addition of pendimethalin can improve control of seedling johnsongrass and itchgrass. Do not apply more than 5.25 qt/A per year.
metribuzin @ 1.5 - 3.0 lb/A	Metribuzin /others (See Table 2) 75DF @ 2.0 - 4.0 lb/A	Seedling johnsongrass and other annual grass and broadleaf weeds	Addition of pendimethalin can improve control of browntop millet and itchgrass. Residual control of red morningglory can be expected for around 35 days.
pendimethalin @ 2.0 - 3.0 lb/A	Prowl/Prowl H₂O /others (See Table 2) 3.3EC formulation @ 2.4 - 3.6 qt/A 3.8CS @ 2.1 - 3.1 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses	May be applied to soil surface or soil incorporated. Use higher rate if surface applied or if itchgrass is a problem. For additional weed control, such as morningglory, atrazine, diuron, metribuzin, or Spartan may be applied with pendimethalin. See precautions for diuron and Spartan.
Pendimethalin @ 1.99 – 2.90 lb/A plus metribuzin @ 0.76 -1.1 lb/A	Tripzin ZC @ 2.75 - 4 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses and broadleaf weeds	Use higher rate on heavy soils.
sulfentrazone @ 0.19 - 0.25 lb/A	Spartan 4F /others @ 6.0 - 8.0 oz/A	Divine nightshade, broadleaf weeds and nutsedge	Use higher rate on heavy soils and where morningglory (tie-vine) is a problem weed. Residual red morningglory control around 90% can be expected for 50 days and control around 80% can be expected at 70 days. Poor control of smallflower morningglory. Injury will occur if herbicide

SUGARCANE WEED MANAGEMENT

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
PREEMERGENCE LAYBY (MAY/JUNE):			
			contacts newly emerging sugarcane shoots and leaves. Do not apply within 120 days of harvest. Can be applied more than once during the growing season but total usage per twelve-month period cannot exceed 12 oz/A.
sulfentrazone @ 0.31 - 0.38 lb/A plus carfentrazone-ethyl @ 0.035 - 0.041 lb/A	Spartan Charge 3.5 SE @ 12.8 - 15.2 oz/A	Divine nightshade, broadleaf weeds and nutsedge	Use higher rate on heavy soils and where morningglory (tie-vine) is a problem weed. Residual red morningglory control around 90% can be expected for 50 days and control around 80% can be expected at 70 days. Poor control of smallflower morningglory. Injury will occur if herbicide contacts newly emerging sugarcane shoots and leaves. Do not apply within 120 days of harvest. Can be applied more than once during the growing season but total usage per twelve-month period cannot exceed 15.2 oz/A.
trifluralin @ 1.5 - 2.0 lb/A	Treflan/Trifluralin/others (See Table 2) 4L @ 1.5 - 2 qt/A	Seedling johnsongrass, itchgrass, browntop millet and other annual grasses	Incorporate within 24 hours after application. Other herbicides should be applied to the soil surface for broadleaf weed control.
flumioxazin @ 0.10 - 0.25 lb/A	Valor SX 51WDG @ 3.0 - 8.0 oz/A	Divine nightshade and broadleaf weeds	Apply when sugarcane is at least 24 inches in height and has begun to joint. Spray contact with more than the lower six inches of sugarcane plants will result in severe injury. Residual red morningglory control can be expected for around 35 days. Valor can be applied at a maximum rate of 12 oz/A per crop year. Do not apply within 90 days of harvest.

SUGARCANE WEED MANAGEMENT

AFTER LAYBY WEED CONTROL (JULY-HARVEST)

Morningglory or tie-vines can cause significant problems at sugarcane harvest. To control morningglory and other broadleaf weeds, herbicides can be applied over the crop canopy by air or ground sprayer, or herbicides can be directed underneath the crop canopy. Coverage of the entire morningglory plant with spray solution will provide the most consistent control. Nonionic surfactant at 1 to 2 qt/100 gal or crop oil concentrate at 2 to 4 qt/100 gal should be added to the spray solution.

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
POSTEMERGENCE AFTER LAYBY (JULY-HARVEST):			
2,4-D @ 0.47 - 1.42 lb/A	2,4-D 3.8L @ 1.0 - 1.5 qt/A (See Table 2) <i>See information below on 2,4-D formulations</i>	Morningglory (tie-vine) and other broadleaf weeds	Apply higher rate if vines are climbing sugarcane plants. Surfactant may be added. Note: Use of 2,4-D is restricted in some parishes. Check local restrictions before application. To avoid potential stand and yield loss in the subsequent plant cane crop, do not apply to seed cane sources 7 weeks prior to harvest and planting. See information below on 2,4-D formulations.
atrazine @ 2.0 - 4.0 lb/A	Atrazine /others (See Table 2) 4L @ 2 - 4 qt/A 90DF @ 2.2 - 4.4 lb/A	Morningglory (tie-vine) and other broadleaf weeds	Apply with surfactant overtop or directed before row closure occurs. Use higher rate if vines are climbing sugarcane plants.
sulfentrazone plus metribuzin @ 0.18 - 0.37 lb/A + 0.27 - 0.56 lb/A	Authority MTZ 45DF @ 16 - 33 oz/A	Morningglory (tie-vine) and other broadleaf weeds and nutsedge	Apply with surfactant as a directed treatment. Injury will occur if herbicide contacts newly emerging sugarcane shoots and leaves. Do not apply more than 33 oz/A in one growing season and within 120 days of harvest.
mesotrione @ 0.09 lb/A	Callisto 4L/others @ 3 oz/A	Morningglory (tie-vine) and other annual broadleaf weeds	Can be applied over the top or as a directed spray. Only one application can be made if Callisto was applied preemergence earlier in the season. Do not harvest sugarcane within 114 days following an over the top application and within 100 days following a directed spray. Addition of atrazine can improve postemergence control of Merrill's nightshade.
mesotrione @ 0.08 - 0.09 lb/A plus atrazine @ 0.5 - 0.6 lb/A	Callisto Xtra @ 20 - 24 oz/A	Morningglory (tie-vine) and other broadleaf weeds	Can be applied over the top or as a directed spray. Only one application can be made if Callisto was applied preemergence earlier in the season. Do not harvest sugarcane within 114 days following an over the top application and within 100 days following a directed spray. Addition of atrazine can improve postemergence control of Merrill's nightshade.
dicamba @ 0.5 - 0.75 lb/A	Clarity/Vision /others (See Table 2) 4L @ 16 - 24 oz/A Engenia 5L @ 12.8 oz/A	Morningglory (tie-vine) and other broadleaf weeds	Apply higher rate if vines are climbing sugarcane plants. Surfactant may be added. Can be used in areas where 2,4-D use is restricted. To avoid potential stand and yield loss in the subsequent plant cane crop, do not apply to

SUGARCANE WEED MANAGEMENT

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
POSTEMERGENCE AFTER LAYBY (JULY-HARVEST):			
			seed cane sources 7 weeks prior to harvest and planting.
trifloxysulfuron-sodium @ 0.014 - 0.028 lb/A	Envoke 75WG @ 0.3 - 0.6 oz/A	Morningglory (tie-vine) and other broadleaf weeds, itchgrass and other annual grasses and purple and yellow nutsedge	Apply as a directed treatment with nonionic surfactant at 1 qt per 100 gallons. Do not apply within 100 days of harvest. A maximum of 3 applications or 1.5 oz/A may be applied per growing season. Do not apply aerially.
paraquat @ 0.50 - 1.0 lb/A	Gramoxone SL/Paraquat/others (See Table 2) 2L @ 1.0 – 3.0 pt/A 3L @ 0.7 – 2.0 pt/A	Small grass and broadleaf weeds and bermudagrass suppression	Apply with surfactant as a directed treatment to the row middles in late June to desiccate bermudagrass. Herbicide contact to young sugarcane tillers and leaves can cause significant injury.
halosulfuron @ 0.03 - 0.06 lb/A	Permit/others (See Table 2) 75WDG @ 0.67 - 1.33 oz/A	Purple and yellow nutsedge	Apply as a directed treatment at 1 to 1.33 oz/A with surfactant to nutsedge growing under the crop canopy.
sulfentrazone @ 0.19 - 0.25 lb/A	Spartan 4F/others @ 6.0 - 8.0 oz/A	Morningglory (tie-vine) and other broadleaf weeds and nutsedge	Apply with surfactant as a directed treatment at the higher rate if morningglory is climbing sugarcane plants. Injury will occur if herbicide contacts newly emerging sugarcane shoots and leaves. If applied in the spring or at layby do not reapply. Do not apply within 120 days of harvest.
sulfentrazone @ 0.31 - 0.38 lb/A plus carfentrazone-ethyl @ 0.035 – 0.041 lb/A	Spartan Charge 3.5 SE @ 12.8 – 15.2 oz/A	Broadleaf weeds and nutsedge	Apply with surfactant as a directed treatment at the higher rate if morningglory is climbing sugarcane plants. Injury will occur if herbicide contacts newly emerging sugarcane shoots and leaves. If applied in the spring or at layby do not reapply. Do not apply within 120 days of harvest. Can be applied more than once during the growing season but total usage per twelve-month period cannot exceed 15.2 oz/A.
flumioxazin @ 0.10 - 0.25 lb/A	Valor SX 51WDG @ 3.0 - 8.0 oz/A	Morningglory (tie-vine) and other broadleaf weeds and some annual grasses	Apply as a directed treatment after sugarcane has begun to joint. Spray contact with more than the lower six inches of sugarcane plants will result in severe injury. Residual red morningglory control can be expected for around 35 days. Valor can be applied at a maximum rate of 12 oz/A per crop year. Do not apply within 90 days of harvest.
2,4-D plus dicamba @ 0.36 - 0.72 lb/A + 0.12 - 0.24 lb/A	Weedmaster/Brash/others (See Table 2) 3.8L @ 0.5 - 1.0 qt/A	Morningglory (tie-vine) and other annual broadleaf weeds	Apply higher rate if vines are climbing sugarcane plants. Surfactant may be added. <u>Note:</u> Use of 2,4-D is restricted in some parishes. Check local restrictions before application. To avoid potential stand and yield loss in the subsequent plant

SUGARCANE WEED MANAGEMENT

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
POSTEMERGENCE AFTER LAYBY (JULY-HARVEST):			
			cane crop, do not apply to seed cane sources 7 weeks prior to harvest and planting.
halosulfuron plus dicamba @ 0.03-0.06 lb/A + 0.14 - 0.28 lb/A	Yukon 67.5WDG @ 4 to 8 oz/A	Purple and yellow nutsedge, small morningglory (tie vines) and other broadleaf weeds	Apply as a directed treatment at 1 to 1.33 oz/A with surfactant to nutsedge growing under the crop canopy. A 8 oz/A rate is equivalent to 1.3 oz/A Permit and 9.0 oz/A Clarity/Vision.

2,4-D Formulations: Acid, amine salt, and ester formulations of **2,4-D** are available (See Table 2 Glossary of Herbicides). Since only the acid form of 2,4-D is active in controlling weeds, the herbicide concentration on the label is provided in lb of ae (acid equivalent) per gal instead of lb of ai (active ingredient) per gal, as is the case with most other herbicides. Amine salt and ester formulations of 2,4-D range from 3.8 to 5.6 lb ae/gal. These numbers are important in determining the amount of formulated product to apply per acre. The lower the lb ae/gal the more formulated product required. For example, a 32 fluid oz rate (1 qt/A) of a 3.8L formulation would correspond to 21.7 oz for a 5.6L formulation. **Unison** is an acid formulation of 2,4-D and contains 1.74 lb ae/gal. The rate range for Unison is 24 to 64 oz/A and rate, like other formulations, is dependent on weed spectrum, density, and size. Unison is less volatile (susceptible to changing from a liquid to a gas where off-target movement can occur) than other 2,4-D formulations. Caution should be used anytime 2,4-D is applied near sensitive plants regardless of formulation.

FALLOW WEED CONTROL

Weed control programs during the fallow period can include use of tillage (deep plowing/disking) and herbicides. Frequent and timely cultivation, where weeds are destroyed and prevented from reestablishing can be an effective management tool especially in dry years. Tillage, especially tillage just prior to planting, can reduce soil moisture in the seedbed, which in dry years can hinder plant cane emergence and growth. Apply preemergence herbicides to a weed-free and clod-free bed. Packing of the row top prior to application may improve weed control.

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
PREEMERGENCE FALLOW:			
atrazine @ 2 lb/A	Atrazine /others (See Table 2) 4L @ 2 qt/A 90DF @ 2.2 lb/A	Broadleaf weeds	Apply to weed free beds. Do not apply more than 10 qt/A or 11.1 lb/A per crop year.
EPTC @ 3.0 - 6.1 lbs/A	Eptam 7-E @ 3.5 - 7 pt/A	Annual grass and broadleaf weeds	Must be thoroughly incorporated 2 to 4 inches deep immediately following application. For bermudagrass and johnsongrass suppression, plants should be turned under and chopped thoroughly prior to treatment. Must be applied 45 days prior to planting sugarcane.
halosulfuron @ 0.03- 0.06 lb/A	Permit /others (See Table 2) 75WDG @ 0.67 - 1.33 oz/A	Purple and yellow nutsedge	A rate of 1 to 1.33 oz/A with surfactant is recommended for control of nutsedge. Can be applied with other herbicides. Do not exceed 2.7 oz/A in one growing season.
pendimethalin @ 2.5 lb/A	Prowl/Prowl H₂O /others (See Table 2) 3.3EC @ 3 qt/A 3.8CS @ 2.6 qt/A	Seedling johnsongrass, itchgrass, browntop millet, other annual grasses	Apply to clean seedbed or incorporate 4 inches deep at least 60 days prior to planting.

SUGARCANE WEED MANAGEMENT

Glyphosate and Glyphosate Mixtures: Postemergence herbicides should be applied to actively growing weeds. Several formulations of **glyphosate** are available with the most common being 4L and 5.5L formulations (See *Table 4 Glyphosate Products*). A 32 oz/A rate (1 qt/A) of a 4L formulation would correspond to 26 oz/A of a 5L formulation and 23 oz/A of a 5.5L formulation. Most formulations of glyphosate contain some surfactant. The need for additional surfactant is based on how much surfactant is present in the formulation and the quality of the surfactant. The herbicide label may state that no additional surfactant is needed or recommended, that surfactant may be added, or that surfactant is required and the amount is specified. See Table 4 for information concerning need for surfactant with the various glyphosate products. Always consult the label for specific information on the need for surfactants and other adjuvants.

Johnsongrass in Fallow: For control of johnsongrass and other weeds, rates of 1 to 2 qt/A of the 4L glyphosate formulation is sufficient (See *Table 4 Glyphosate Products*). Do not cultivate for 7 days after application to allow adequate time for the glyphosate to be taken into the plant and moved to underground rhizomes. Under heavy weed infestation, two to three weeks between glyphosate application and planting will allow time for johnsongrass to desiccate and will promote more efficient opening of rows and covering of planted sugarcane. When applying 2,4-D in combination with glyphosate for additional broadleaf weed control, use the high end of the glyphosate rate to avoid a possible reduction in grass control (antagonism).

Broadleaf Weeds in Fallow: **Atrazine**/others 4L at 1 to 2 qt/A, **Aim** 2EC at 1 to 2 oz/A, and **Valor** 51WDG at 3 to 4 oz/A, can be applied to control broadleaf weeds and in particular morningglory (tie-vine). The higher rates should be applied to control large vining weeds. Atrazine/others and Aim can be applied any time during the fallow period. Valor can be applied from 2 weeks prior to planting to before sugarcane emerges.. Some residual weed control can be expected with **Atrazine**/others or **Valor**; however, **Aim** has no soil residual activity. Nonionic surfactant at 1 to 2 qt/100 gal or crop oil concentrate at 2 to 4 qt/100 gal should be added to the spray solution. If applied with glyphosate, surfactant present in the glyphosate formulation may be adequate. See Table 4 for information concerning need for surfactant with the various glyphosate products. Always consult the label for specific information on the need for surfactants and other adjuvants.

Bermudagrass in Fallow: In fields where bermudagrass population is high, tillage in combination with glyphosate is most effective. Apply 2 to 3 qt/A of the 4L glyphosate formulation for control of bermudagrass with less than 8-inch runners. See Table 4 for information concerning need for surfactant with the various glyphosate products. Always consult the label for specific information on the need for surfactants and other adjuvants. Retreatment with 2 to 3 qt/A may be necessary to maintain control. Do not cultivate for 7 days after application to allow adequate time for the glyphosate to be taken into the plant and moved to underground rhizomes. Under heavy weed infestation, two to three weeks between glyphosate application and planting will allow time for bermudagrass to desiccate and will promote more efficient opening of rows and covering of planted sugarcane. **Multiple applications of glyphosate are more effective in controlling bermudagrass than a single application.**

Purple and Yellow Nutsedge in Fallow: **Permit**/others 75 WDG at 1.0 to 1.33 oz/A, **Yukon** 67.5 WDG at 6 to 8 oz/A and **Envoke** 75WG at 0.15 to 0.2 oz/A applied with nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 4 qt/100 gal of water will provide some control of nutsedge. The higher rate is needed when nutsedge is large and the population is dense. For best results herbicide application should be made before nutsedge is 6 inches tall. If application is delayed until nutsedge forms a dense mat on the soil surface a sizeable tuber population will have developed underground and control will be reduced.. **Permit**/others, **Yukon** and **Envoke** can be applied with glyphosate products without negatively affecting grass control. If applied with glyphosate, surfactant present in the glyphosate formulation may be adequate. See Table 4 for information concerning need for surfactant with the various glyphosate products. Always consult the label for specific information on the need for surfactants and other adjuvants. If two applications of glyphosate are planned, **Permit**/others, **Yukon**, or **Envoke** should be applied with glyphosate in the first application. The follow up application of glyphosate alone should be effective on nutsedge regrowth. **Yukon**, a premix of halosulfuron (the active ingredient in Permit) and dicamba (the active ingredient in Clarity/Vision/others) and Envoke will also provide some control of broadleaf weeds. For **Yukon**, a 6 oz/A rate is equivalent to 1.0 oz/A **Permit** 75WDG and 6.6 oz/A **Clarity/Vision** 4L and a 8 oz/A rate is equivalent to 1.3 oz/A **Permit** and 9.0 oz/A **Clarity/Vision**. As also noted for glyphosate, do not cultivate for 7 days after application of **Permit**/others, **Yukon**, or **Envoke** to allow adequate time for movement of herbicide to underground nutsedge tubers.

In situations where nutsedge and other weeds may interfere with row opening at planting, **Gramoxone SL** 2L at 3 pt/A or **Paraquat**/others 3L at 2 pt/A plus nonionic surfactant at 1 to 2 qt/100 gal or crop oil concentrate at 2 to 4 qt/100 gal can be applied 1 to 2 weeks before planting to desiccate weeds. Because herbicide does not move to underground nutsedge tubers, rapid reestablishment should be expected, consider applying Authority MTZ, or Spartan at-planting or the use of **Permit**/others, **Yukon**, **Envoke**, in September or October. See “At-Planting Weed Control (August/September)” and “Postemergence Weed Control (September-November)” sections.

SUGARCANE WEED MANAGEMENT

Doveweed in Fallow: Doveweed is a summer annual weed that emerges from mid-June through September. Doveweed as well as many other members of the dayflower family are poorly controlled with glyphosate. In fallow programs where glyphosate is the only herbicide used for weed control, doveweed can form a dense mat across the row and can interfere with row opening at planting. In fields with a known history of doveweed, **glyphosate** should be applied with **Metribuzin/others 75DF** at 1.3 lb/A or **Valor SX 51WDG** at 6 to 8 oz/A in June to control weeds on formed beds. Metribuzin/others 75DF should provide preemergence control of doveweed up to 60 days after application. For emerged doveweed, effective control may be obtained with **Gramoxone SL 2L** at 3 pt/A or **Paraquat/others 3L** at 2 pt/A, **Atrazine/others 4L** at 2 qt/A, or **Metribuzin/others** at 1.5 lb/A applied 1 to 3 weeks before planting. Nonionic surfactant at 1 to 2 qt/100 gal or crop oil concentrate at 2 to 4 qt/100 gal should be added to the spray solution for postemergence applications. Application of **Gramoxone SL 2L** at 2 pt/A or **Paraquat/others 3L** at 1.33 pt/A with **Atrazine/others** at 2 qt/A or application of **Metribuzin/others 75DF** at 1 lb/A with **Weedmaster/Brash/others 3.8L** at 1.5 pt/A were effective when planting was delayed beyond 3 weeks after application.

No-Tillage Fallow Program: In a no-tillage program, sugarcane stubble must be destroyed with herbicide. To obtain around 90% control of sugarcane stubble, glyphosate 4L should be applied at 1.0 qt/A (6-inch stubble), 1.5 qt/A (10 inch stubble), 2.0 qt/A (16 inch stubble) and 2.5 qt/A (18 inch stubble) (See Table 4 *Glyphosate Products*). Typically, in a no-tillage program a second glyphosate application will be needed to control weeds and any sugarcane regrowth that might occur. It is important that the first glyphosate application be made by the end of April to allow for sugarcane to completely decompose before rows are worked at planting. In fields where bermudagrass population is high, a no-tillage program where glyphosate is used for weed control may not be as effective as glyphosate in combination with tillage.

Note: Glyphosate herbicides can be applied by air, but extreme caution should be used due to problems with off-target movement and damage to sugarcane and other crops in areas adjacent to treated fields.

SUGARCANE WEED MANAGEMENT

DITCHBANK WEED CONTROL

Problem weeds, such as johnsongrass, itchgrass, bermudagrass, poppingweed (*Equisetum*/horsetail) and *Rubus* species (briars), should be controlled on ditchbanks. This will aid in field drainage and prevent weed movement into adjacent sugarcane fields. These recommendations are for nonirrigation drainage ditch use only. **DO NOT** apply herbicides to a ditch when water is present unless specifically allowed based on the herbicide label. Herbicides should be applied in a minimum of 20 gallons of water per acre spray volume.

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
DITCHBANK WEED CONTROL:			
2,4-D plus triclopyr @ 2.0 + 1.0 lb/A	Crossbow 3L @ 4.0 qt/A (See Table 3)	Poppingweed, briars and woody species	Best control obtained when applied to young poppingweed, less than 2 years old. For control of briars and smaller diameter woody species, apply at 1.0 to 1.5 gal/100 gal of water and add nonionic surfactant at 1 qt/100 gal of water. Apply in a spray volume of 40 to 60 gal per acre to thoroughly soak all stems and plant crowns at the soil line. This product contains 2,4-D and use may be restricted in some areas of the state.
diuron @ 2.0 - 15.0 lb/A	Diuron/Direx /others (See Table 2) 4L @ 2.0 - 15.0 qt/A 80DF @ 2.5 - 18.8 lb/A	Annual grass and broadleaf weeds	Provides residual control of many annual weeds. Addition of nonionic surfactant at 1 to 2 qt/100 gal of water or crop oil concentrate at 2 to 4 qt/100 gal of water will increase contact activity on small, emerged weeds no more than 3 in tall. Herbicide activity will be improved if soil in the ditch is moist at application. Do not allow herbicide to contact roots of desirable plants when applied at the higher rates.
triclopyr @ 2.0 - 3.0 lb/A	Garlon /others (See Table 3) 4L @ 2.0 - 3.0 qt/A or 3L @ 2.7 - 4.0 qt/A	Poppingweed, briars and woody species	Control is greater when applied to young poppingweed, less than 2 years old. For control of briars and smaller diameter woody species, apply at 1.5 pt/A of 4L formulation or 2 pt/A of 3A formulation plus nonionic surfactant at 1 to 2 qt/100 gal of water. Apply in a spray volume of 40 to 60 gal per acre to thoroughly soak all stems and plant crowns at the soil line. <u>Note:</u> Garlon 4 at 1 gallon per 80 gallons water plus 1% Roundup has been effective on poppingweed when plants were thoroughly wetted.
triclopyr plus glyphosate	Garlon /others (See Table 3) Roundup /others (See Table 4) See Remarks and Precautions for rates and mixing instructions	Poppingweed and other ditchbank weeds	For a 100-gallon total spray mix, include 5 qt of Garlon 4, Triquad 4L, or other triclopyr product with a 4L concentration and 4 qt of a Roundup/glyphosate product with a 5.5L concentration or 5.5 quarts of a 4L glyphosate product. If the glyphosate formulation does not contain surfactant, add nonionic surfactant at 2 quarts per 100 gallons of water. Because herbicide rates are <u>not</u> specified in product per acre, spray

SUGARCANE WEED MANAGEMENT

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
DITCHBANK WEED CONTROL:			
			volume (gallons per acre) will affect herbicide rate per unit area treated, number of acres of ditchbank treated and cost per acre. In general, spray volume should be in the range of 20 to 40 gallons per acre. A standard multi-nozzle spray boom positioned over the ditch, a hand gun (cattle gun sprayer), or a single stationary nozzle sprayer can be used for application. It is important that poppingweed foliage be well covered. Herbicide should not be applied to a ditch when water is present unless specifically allowed based on the herbicide label. <u>Note:</u> Treating only the bottom of the ditch and not the sides will allow for water movement and will also help to reduce ditchbank erosion.
pendimethalin @ 2.5 - 3.3 lb/A	Prowl/Prowl H₂O /others (See Table 2) 3.3EC @ 3.0 - 4.0 qt/A 3.8CS @ 2.6 - 3.5 qt/A	Seedling johnsongrass, itchgrass and other annual grasses	Apply in a minimum of 20 gal per acre spray volume prior to weed emergence; will NOT control emerged weeds. May apply with postemergence herbicides to provide residual activity.
glyphosate @ 1.0 - 5.0 lb/A	Roundup /others (See Table 4) 4L @ 1.0 to 5.0 qt/A 5L @ 0.8 to 4.0 qt/A 5.5L @ 0.7 to 3.6 qt/A	Johnsongrass, itchgrass and other weeds	Johnsongrass, itchgrass and most other weeds are controlled at 1 to 2 qt/A of the 4L glyphosate formulation. Apply 2 to 3 qt/A for control of bermudagrass with less than 8-inch runners. Retreatment with 2 to 3 qt/A may be necessary to maintain bermudagrass control. Application with diuron at 5.0 lb ai/A (see information on diuron) or Velpar 2L at 1.0 qt/A or Velossa 2.4L at 1.6 pt/A and Diuron/Direx/others 4L at 2.5 qt/A can increase initial control and provide extended control of many annual weeds. Do not allow herbicide to contact foliage of desirable plants.
hexazinone @ 0.5 lb/A plus diuron @ 2.5 lb/A	Velpar 2L @ 1.0 qt/A or Velossa 2.4L @ 1.6 pt/A plus Diuron/Direx /others (See Table 2) 4L at 2.5 qt/A	Most ditchbank weeds including some control of poppingweed	Will not control rhizome johnsongrass or curly dock. Do not use on out-flow ditches or ditches not directly between two cane fields. Very slow activity on poppingweed. Inclusion of 2 qt/A of a 4L glyphosate formulation or 2.67 qt/A of a 6L MSMA formulation has increased rhizome johnsongrass and curly dock control. Apply in a spray volume of at least 40 gal per acre to thoroughly cover the soil and foliage and soak all stems and plant crowns at the soil line. Nonionic surfactant at 1 qt/100 gal of water or crop oil concentrate at 1 gallon/100 gal of water should be added.

SUGARCANE WEED MANAGEMENT

Active Ingredient and Rate	Formulated Product and Rate	Weeds Controlled	Remarks and Precautions
DITCHBANK WEED CONTROL:			
2,4-D plus dicamba @ 0.36 - 2.15 lb/A + 0.12 - 0.75 lb/A	Weedmaster/Brash /others (See Table 2) 3.8L @ 0.5 - 3.0 qt/A	Broadleaf weeds	Use 1 qt/A to control annual broadleaf weeds and 1 to 3 qt/A for suppression of perennial weeds. This product contains 2,4-D and use may be restricted in some areas of the state.

SUGARCANE WEED MANAGEMENT

TABLE 1. EFFECTIVENESS OF SELECTED SUGARCANE HERBICIDES APPLIED PREEMERGENCE AND POSTEMERGENCE IN-CROP AND IN FALLOW.

Weed control estimates represent 28 to 35 days after application of preemergence herbicides and 14 to 21 days after application of postemergence herbicides at the high end of the rate range. A value of 0 = no control and 10 = 100% control.

	Seedling Johnsongrass	Rhizome Johnsongrass	Itchgrass (Raoulgrass)	Bermudagrass ¹	Browntop Millet	Annual Grasses	Morningglory (Tie-vines)	Other Broadleaf Weeds	Nutsedges	Doweweed	Winter Grasses ²	Winter Broadleaf Weeds ³
PREEMERGENCE APPLICATION:												
Atrazine/others	2	0	2	0	4	5	8	9	2	5	8	9
Authority MTZ	5	0	2	1	5	5	9	8	7	-	5	8
Callisto	2	0	0	0	5	5	5 ⁶	8	2	8	3	7
Command	8	2	8	6	8	8	3	3	2	-	7	2
Command plus Diuron/Direx/ others or Metribuzin/others	9	2	8	8	9	9	6	8	2	-	7	8
Diuron/Direx/others	7	0	5	1	6	6	6	8	2	3	7	8
Eptam ⁴	8	6	-	6	-	-	7	6	5	-	2	2
Prowl/others	8	2	8	2	8	9	2	2	3	0	6	2
Prowl plus Velpar/Velossa + Diuron/Direx/others	8	2	8	5	9	9	7	8	3	9	7	8
Prowl plus Metribuzin/others	9	2	8	5	9	9	8	9	4	9	8	8
Lumax EZ	7	0	2	0	9	9	8	9	7	8	9	9
Metribuzin/others	9	0	2	6	6	9	8	9	5	9	8	8
Sinbar	9	0	2	8	3	9	7	7	5	-	6	5
Spartan	4	0	2	0	3	4	9	8	7	-	4	8
Spartan Charge	4	0	2	0	3	4	9	8	7	-	4	8
Treflan/Trifluralin/others ⁴	9	6	9	7	9	9	2	2	5	-	8	2
Valor	3	0	2	0	3	4	8	9	6	-	8	9
Velpar/Velossa + Diuron/Direx/ others or Metribuzin/others	8	2	7	7	8	9	7	8	5	9	8	8
POSTEMERGENCE APPLICATION:												
Aim	0	0	0	0	0	0	9	8	0	0	-	-
Armezon	-	1	1	5	-	8	-	8	-	-	-	-
Asulox/Asulam ⁵	8	7	7	2	8	9	0	0	0	-	-	-
Atrazine/others	2	0	2	0	2	6	9	9	2	7	4	7
Callisto	0	0	1	0	4	4	6 ^{6,7}	8	2	-	-	8
Callisto + Atrazine/others	2	0	2	0	6	7	9	8	2	7	4	7
Clarity/Vision/others	0	0	0	0	0	0	9	9	3	6	0	9
Diuron/Direx/others	6	2	5	0	5	8	7	8	2	-	6	6
Envoke ⁵	7	4	8	1	7	9	6	8	7	2	-	-

SUGARCANE WEED MANAGEMENT

Envoke + Asulox/Asulam ⁵	8	7	9	2	8	9	6	8	7	2	7	7
Glyphosate herbicides	9	9	9	8	9	9	6	7	6	4	8	8
Gramoxone SL/ Paraquat/others	8	2	8	4	8	9	8	8	2	8 ⁶	8	8
Permit/others	1	0	0	0	0	1	4	4	8	0	0	0
Spartan	2	0	2	0	2	4	9	8	7	-	3	8
Spartan Charge	2	0	2	0	2	4	9	8	7	-	3	8
Valor	2	0	2	0	3	4	9	8	2	5 ⁶	2	8
Weedmaster/Brash/others	0	0	0	0	0	0	9	9	3	6	0	9
Yukon	0	0	0	0	0	0	8	8	8	6	0	8
2,4-D/others	0	0	0	0	0	0	9	9	3	6	0	9

¹ Expected control level with application at planting prior to weed emergence and following a good fallow program or when applied in late winter prior to weed emergence from the winter dormant period.

² Winter grasses include ryegrass, rescuegrass and timothy grass.

³ Winter broadleaf weeds include sowthistle, wild geranium and clovers.

⁴ Herbicide must be incorporated.

⁵ Requires 28 to 35 days to reach maximum control.

⁶ Addition of atrazine improves control.

⁷ For best results, apply before morningglory exceed 5 inches in height.

SUGARCANE WEED MANAGEMENT

TABLE 2. GLOSSARY OF HERBICIDES REGISTERED FOR USE IN SUGARCANE IN LOUISIANA.¹

Common name	Trade Name	Manufacturer or Distributor	Group No. Based on Mechanism of Action	EPA Registration No.
2,4-D	SAVAGE DRY SOLUBLE	Loveland Products, Inc.	Group 4	34704-606
2,4-D	UNISON NOVEL BROADLEAF	Helena Chemical Company	Group 4	5905-542
2,4-D, 2-ethylhexyl ester	LO-VOL 4 SOLVENTLESS	TENKOZ, Inc.	Group 4	71368-14-55467
2,4-D, 2-ethylhexyl ester	WEEDONE LV4 SOLVENTLESS	Nufarm Agricultural Products	Group 4	71368-14
2,4-D, diethanolamine salt + 2,4-D, dimethylamine salt	HI-DEP	PBI Gordon Corporation	Group 4; Group 4	2217-703
2,4-D, dimethylamine salt	2,4-D AMINE 4 (AGRI STAR)	Albaugh, Inc./Agri Star	Group 4	42750-19
2,4-D, dimethylamine salt	2,4-D AMINE-4	Winfield Solutions LLC	Group 4	1381-103
2,4-D, dimethylamine salt	AMINE 4 2,4-D	Loveland Products, Inc.	Group 4	34704-120
2,4-D, dimethylamine salt	AMINE 4 2,4-D HERBICIDE	TENKOZ, Inc.	Group 4	42750-19-55467
2,4-D, dimethylamine salt	AMINE 4 2,4-D, TENKOZ	TENKOZ, Inc.	Group 4	71368-1-55467
2,4-D, dimethylamine salt	CLEAN AMINE	Loveland Products, Inc.	Group 4	34704-120
2,4-D, dimethylamine salt	OPTI-AMINE	Helena Chemical Company	Group 4	5905-501
2,4-D, dimethylamine salt	SABER	Loveland Products, Inc.	Group 4	34704-803
2,4-D, dimethylamine salt	SOLUTION WATER SOLUBLE	Nufarm Agricultural Products	Group 4	228-260
2,4-D, dimethylamine salt	WEEDAR 64	Nufarm Agricultural Products	Group 4	71368-1
2,4-D, dimethylamine salt	WEDESTROY AM-40 AMINE SALT	Nufarm Agricultural Products	Group 4	228-145
2,4-D, dimethylamine salt + Dicamba, dimethylamine salt	BRASH HERBICIDE	Winfield Solutions LLC	Group 4; Group 4	1381-202
2,4-D, dimethylamine salt + Dicamba, dimethylamine salt	RANGESTAR	Albaugh, Inc./Agri Star	Group 4; Group 4	42750-55
2,4-D, dimethylamine salt + Dicamba, dimethylamine salt	RIFLE-D	Loveland Products, Inc.	Group 4; Group 4	34704-869
2,4-D, dimethylamine salt + Dicamba, dimethylamine salt	WEEDMASTER	Nufarm Agricultural Products	Group 4; Group 4	71368-34
2,4-D + Dicamba	LATIGO	Helena Chemical Company	Group 4; Group 4	5905-564
Asulam-sodium	ASULAM HERBICIDE	Loveland Products, Inc.	Group 18	34704-904
Asulam-sodium	ASULOX	United Phosphorus, Inc.	Group 18	70506-139
Atrazine	AATREX 4L HERBICIDE	Syngenta Crop Protection, LLC	Group 5	100-497
Atrazine	AATREX NINE-O	Syngenta Crop Protection, LLC	Group 5	100-585
Atrazine	ATRAZINE 4 L	Winfield Solutions LLC	Group 5	1381-158
Atrazine	ATRAZINE 4 L HERBICIDE	Helena Chemical Company	Group 5	5905-470
Atrazine	ATRAZINE 4L	Loveland Products, Inc.	Group 5	34704-69
Atrazine	ATRAZINE 4L (DREXEL)	Drexel Chemical Company	Group 5	19713-11
Atrazine	ATRAZINE 4L HERBICIDE	MANA - Makhteshim Agan of North America, Inc.	Group 5	66222-36
Atrazine	ATRAZINE 4L HERBICIDE	TENKOZ, Inc.	Group 5	100-497-55467
Atrazine	ATRAZINE 90 DF	Winfield Solutions LLC	Group 5	9779-253

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Common name	Trade Name	Manufacturer or Distributor	Group No. Based on Mechanism of Action	EPA Registration No.
Atrazine	ATRAZINE 90 DF HERBICIDE	MANA - Makhteshim Agan of North America, Inc.	Group 5	66222-37
Atrazine	ATRAZINE 90 WDG	Loveland Products, Inc.	Group 5	34704-622
Atrazine	ATRAZINE 90DF HERBICIDE	TENKOZ, Inc.	Group 5	100-585-55467
Atrazine	HELENA ATRAZINE 4F	Helena Chemical Company	Group 5	100-497-5905
Carfentrazone-ethyl	AIM EC HERBICIDE	FMC Corporation Agricultural Products Group	Group 14	279-3241
Carfentrazone-ethyl	AIM EW HERBICIDE	FMC Corporation Agricultural Products Group	Group 14	279-3242
Clomazone	COMMAND 3 ME	Helena Chemical Company	Group 13	279-3158-5905
Clomazone	COMMAND 3ME	FMC Corporation Agricultural Products Group	Group 13	279-3158
Dicamba	VISION HERBICIDE	Helena Chemical Company	Group 4	5905-576
Dicamba, diglycolamine salt	CLARITY HERBICIDE	BASF Ag Products	Group 4	7969-137
Dicamba, diglycolamine salt	CLASH	Nufarm Agricultural Products	Group 4	228-615
Dicamba, diglycolamine salt	DETONATE	TENKOZ, Inc.	Group 4	7969-137-55467
Dicamba, diglycolamine salt	STERLING BLUE	Winfield Solutions LLC	Group 4	7969-137-1381
Dicamba, diglycolamine salt	STRUT	Loveland Products, Inc.	Group 4	34704-1043
Dicamba, dimethylamine salt	BANVEL HERBICIDE	Arysta LifeScience North America LLC	Group 4	66330-276
Dicamba, dimethylamine salt	DIABLO HERBICIDE	Nufarm Agricultural Products	Group 4	228-379
Dicamba, dimethylamine salt	RIFLE	Loveland Products, Inc.	Group 4	34704-861
Dicamba, BAPMA salt	ENGENIA	BASF Ag Products	Group 4	7969-345
Diuron	DIREX 4 L	MANA - Makhteshim Agan of North America, Inc.	Group 7	66222-54
Diuron	DIREX 4L HERBICIDE	DuPont Crop Protection	Group 7	352-678
Diuron	DIURON 4 L	Winfield Solutions LLC	Group 7	9779-329
Diuron	DIURON 4L	Drexel Chemical Company	Group 7	19713-36
Diuron	DIURON 4L HERBICIDE	MANA - Makhteshim Agan of North America, Inc.	Group 7	66222-54
Diuron	DIURON 80	Drexel Chemical Company	Group 7	19713-274
Diuron	DIURON 80 WDG WEED KILLER	Loveland Products, Inc.	Group 7	34704-648
Diuron	DIURON 80DF	MANA - Makhteshim Agan of North America, Inc.	Group 7	66222-51
Diuron	DIURON-4L HERBICIDE	Loveland Products, Inc.	Group 7	34704-854
Diuron	PARROT DF	MANA - Makhteshim Agan of North America, Inc.	Group 7	66222-51
Diuron	SEKOR 4L	MANA - Makhteshim Agan of North America, Inc.	Group 7	66222-54
Diuron	SUPERDI 4L	MANA - Makhteshim Agan of North America, Inc.	Group 7	66222-54
EPTC	EPTAM 7-E	Gowan Company	Group 8	10163-283

SUGARCANE WEED MANAGEMENT

Common name	Trade Name	Manufacturer or Distributor	Group No. Based on Mechanism of Action	EPA Registration No.
Flumioxazin	VALOR SX	Valent U.S.A. Corporation Agricultural Products	Group 14	59639-99
Halosulfuron-methyl	PERMIT	Gowan Company	Group 2	81880-2-10163
Halosulfuron-methyl	SANDEA	Gowan Company	Group 2	81880-18-10163
Halosulfuron-methyl + Dicamba, sodium salt	YUKON HERBICIDE	Gowan Company	Group 4; Group 2	81880-6-10163
Hexazinone	VELOSSA	Helena Chemical Company	Group 5	5905-579
Hexazinone	VELPAR DF	DuPont Crop Protection	Group 5	352-581
Hexazinone	VELPAR L HERBICIDE	DuPont Crop Protection	Group 5	352-392
Mesotrione	CALLISTO	Syngenta Crop Protection, LLC	Group 27	100-1131
Mesotrione	MESOTRYONE	Drexel Chemical Company	Group 27	19713-685
Mesotrione + Atrazine	CALLISTO XTRA	Syngenta Crop Protection, LLC	Group 5; Group 27	100-1359
Metribuzin	DIMETRIC DF 75%	Winfield Solutions LLC	Group 5	1381-197
Metribuzin	GLORY	MANA - Makhteshim Agan of North America, Inc.	Group 5	66222-106
Metribuzin	METRI 4F	United Phosphorus, Inc.	Group 5	70506-68
Metribuzin	METRI DF HERBICIDE	United Phosphorus, Inc.	Group 5	70506-103
Metribuzin	METRIBUZIN 75	Loveland Products, Inc.	Group 5	34704-876
Metribuzin	METRIBUZIN 75DF	MANA - Makhteshim Agan of North America, Inc.	Group 5	66222-106
Metribuzin	TRICOR 4F	United Phosphorus, Inc.	Group 5	70506-68
Metribuzin	TRICOR DF	United Phosphorus, Inc.	Group 5	70506-103
Paraquat dichloride	BONFIRE	United Phosphorus, Inc.	Group 22	70506-239
Paraquat dichloride	FIRESTORM	Chemtura USA Corporation	Group 22	82557-1-400
Paraquat dichloride	GRAMOXONE INTEON	Syngenta Crop Protection, LLC	Group 22	100-1217
Paraquat dichloride	GRAMOXONE SL	Syngenta Crop Protection, LLC	Group 22	100-1217
Paraquat dichloride	GRAMOXONE SL 2.0	Syngenta Crop Protection, LLC	Group 22	100-1431
Paraquat dichloride	HELMQUAT 3SL	HELM AGRO US, Inc.	Group 22	74530-48
Paraquat dichloride	PARAQUAT CONCENTRATE	Solera Source Dynamics, LLC	Group 22	82542-3
Paraquat dichloride	PARA-SHOT 3.0	Sharda USA LLC	Group 22	83529-27
Paraquat dichloride	PARAZONE 3SL	MANA - Makhteshim Agan of North America, Inc.	Group 22	66222-130
Paraquat dichloride	QUIK-QUAT	Drexel Chemical Company	Group 22	19713-617
Pendimethalin	ACUMEN	TENKOZ, Inc.	Group 3	241-337-55467
Pendimethalin	FRAMEWORK 3.3 EC	Winfield Solutions LLC	Group 3	1381-216
Pendimethalin	PENDANT 3.3 EC	Winfield Solutions LLC	Group 3	241-337-1381
Pendimethalin	PENDIPRO 3.3 EC	Independent Agribusiness Professionals, Inc.	Group 3	241-337-71058
Pendimethalin	PROWL 3.3 EC HERBICIDE	BASF Ag Products	Group 3	241-337
Pendimethalin	SATELLITE 3.3 HERBICIDE	United Phosphorus, Inc.	Group 3	70506-318
Pendimethalin	SATELLITE FLEX HERBICIDE	United Phosphorus, Inc.	Group 3	70506-324
Pendimethalin	PROWL H2O	BASF Ag Products	Group 3	241-418

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Common name	Trade Name	Manufacturer or Distributor	Group No. Based on Mechanism of Action	EPA Registration No.
Pendimethalin	SATELLITE HYDROCAP HERBICIDE	United Phosphorus, Inc.	Group 3	70506-230
Pendimethalin	STEALTH	Loveland Products, Inc.	Group 3	34704-868
Pendimethalin + metribuzin	TRIPZIN ZC	United Phosphorus, Inc.	Group 3; Group 5	70506-330
S-metolachlor + atrazine + mesotrione	LUMAX EZ	Syngenta Crop Protection, LLC	Group 15; Group 5; Group 27	100-1442
Sulfentrazone	SPARTAN 4F HERBICIDE	FMC Corporation Agricultural Products Group	Group 14	279-3220
Sulfentrazone	VANDAL 4SC	Loveland Products, Inc.	Group 14	89168-48 89391
Sulfentrazone	SHUTDOWN HERBICIDE	United Phosphorus, Inc.	Group 14	70506-326
Sulfentrazone + Carfentrazone-ethyl	SPARTAN CHARGE HERBICIDE	FMC Corporation Agricultural Products Group	Group 14; Group 14	279-3337
Sulfentrazone + Metribuzin	AUTHORITY MTZ DF	FMC Corporation Agricultural Products Group	Group 5; Group 14	279-3340
Terbacil	SINBAR WDG	Tessenderlo Kerley, Inc. (NovaSource)	Group 5	61842-27
Topramezon	ARMEZON	BASF Ag Products	Group 27	7969-262
Triclopyr ²	TRYCERA	Helena Chemical Company	Group 4	5905-580
Trifloxysulfuron-Sodium	ENVOKE	Syngenta Crop Protection, LLC	Group 2	100-1132
Trifluralin	DINTEC TREFLAN 4D HERBICIDE	Dintec Agrichemicals	Group 3	68156-4
Trifluralin	TREFLAN 4 EC HERBICIDE	Helena Chemical Company	Group 3	5905-532
Trifluralin	TREFLAN 4L	Loveland Products, Inc.	Group 3	34704-853
Trifluralin	TREFLAN HFP	Dow AgroSciences LLC	Group 3	62719-250
Trifluralin	TREFLAN TR-10 HERBICIDE	Dow AgroSciences LLC	Group 3	62719-131
Trifluralin	TRIFLURALIN 10G	Loveland Products, Inc.	Group 3	34704-790
Trifluralin	TRIFLURALIN 4 E.C., HELENA	Helena Chemical Company	Group 3	5905-519
Trifluralin	TRIFLURALIN 4 EC (AGRI STAR)	Albaugh, Inc./Agri Star	Group 3	42750-32
Trifluralin	TRIFLURALIN 4 EC, TENKOZ	TENKOZ, Inc.	Group 3	62719-250-55467
Trifluralin	TRIFLURALIN 4EC, TENKOZ	TENKOZ, Inc.	Group 3	66222-46-55467
Trifluralin	TRIFLURALIN HF	Loveland Products, Inc.	Group 3	34704-792
Trifluralin	TRIFLUREX HFP	MANA - Makhteshim Agan of North America, Inc.	Group 3	66222-46
Trifluralin	TRUST 10G	Winfield Solutions LLC	Group 3	62719-131-1381
Trifluralin	TRUST HERBICIDE	Winfield Solutions LLC	Group 3	1381-146

¹Information provided by the Louisiana Department of Agriculture and Forestry through the [Pesticide Registration](#) website and from the [CDMS](#) website. This list is not inclusive of all products available. See herbicide label for specific crops and uses. The LSU AgCenter does not recommend or endorse specific herbicide brands.

²EPA has granted a Section 18 Quarantine Emergency Exemption for use of **Trycera** to manage divine nightshade until May 31, 2020. **Trycera** may be applied from October 1 to May 31 in all commercial sugarcane parishes at 0.7 to 2.1 qt/A. Application is limited to ground rig application, and a minimum of 15 gallons per acre should be used.

SUGARCANE WEED MANAGEMENT

TABLE 3. GLOSSARY OF HERBICIDES REGISTERED FOR USE ON SUGARCANE DITCHBANKS IN LOUISIANA.¹

Common name	Trade Name	Manufacturer or Distributor	Group No. Based on Mechanism of Action	EPA Registration No.
2,4-D, butoxyethyl ester+ Triclopyr, butoxyethyl ester	CANDOR	Nufarm Agricultural Products	Group 4; Group 4	228-565
2,4-D, butoxyethyl ester+ Triclopyr, butoxyethyl ester	CROSSBOW HERBICIDE	Dow AgroSciences LLC	Group 4; Group 4	62719-260
2,4-D, butoxyethyl ester+ Triclopyr, butoxyethyl ester	CROSSBOW L	Loveland Products, Inc.	Group 4; Group 4	62719-260-34704
2,4-D, butoxyethyl ester+ Triclopyr, butoxyethyl ester	CROSSBOW, TENKOZ	TENKOZ, Inc.	Group 4; Group 4	62719-260-55467
2,4-D, dimethylamine salt+ Triclopyr, triethylamine salt	AQUASWEEP	Nufarm Agricultural Products	Group 4; Group 4	228-316
Triclopyr	TRYCERA	Helena Chemical Company	Group 4	5905-580
Triclopyr	ELEMENT 4	Dow AgroSciences LLC	Group 4	62719-40
Triclopyr	RELEGATE RTU	Nufarm Agricultural Products	Group 4	228-552
Triclopyr, butoxyethyl ester	GARLON 4	Dow AgroSciences LLC	Group 4	62719-40
Triclopyr, butoxyethyl ester	GARLON 4 ULTRA	Dow AgroSciences LLC	Group 4	62719-527
Triclopyr, butoxyethyl ester	PATHFINDER II	Dow AgroSciences LLC	Group 4	62719-176
Triclopyr, butoxyethyl ester	REMEDY ULTRA	Dow AgroSciences LLC	Group 4	62719-552
Triclopyr, butoxyethyl ester	TAHOE 4E HERBICIDE	Nufarm Agricultural Products	Group 4	228-517
Triclopyr, triethylamine salt	GARLON 3A	Dow AgroSciences LLC	Group 4	62719-37
Triclopyr, triethylamine salt	PLATFORM HERBICIDE	Nufarm Agricultural Products	Group 4	228-520
Triclopyr, triethylamine salt	TAHOE 3A	Nufarm Agricultural Products	Group 4	228-520

¹Information provided by the Louisiana Department of Agriculture and Forestry through the [Pesticide Registration](#) website and from the [CDMS](#) website. This list is not inclusive of all products available. See herbicide label for specific crops and uses. The LSU AgCenter does not recommend or endorse specific herbicide brands.

SUGARCANE WEED MANAGEMENT

TABLE 4. GLYPHOSATE PRODUCTS REGISTERED FOR USE IN LOUISIANA WITH SURFACTANT RECOMMENDATIONS.¹

					Rate Equivalent Based on 4 lb ai/gal Product	Rate Equivalent Based on 4 lb ai/gal Product	Rate Equivalent Based on 4 lb ai/gal Product
Trade Name	Manufacturer or Distributor	Glyphosate Concentration ² Acid equivalent (a.e)	Glyphosate Concentration ² Active ingredient (a.i.)	Need for Nonionic Surfactant ³	1.0 qt	1.5 qt	2.0 qt
Abundit Extra	Nufarm	3	4	No	1.0	1.5	2.0
Atila	Nufarm	3	4	May be added*	1.0	1.5	2.0
Atila Extra	Nufarm	3	4	No	1.0	1.5	2.0
Atila Plus	Nufarm	3	4	No	1.0	1.5	2.0
Buchaneer	Tenkoz	3	4	May be added**	1.0	1.5	2.0
Buchaneer Plus	Tenkoz	3	4	May be added***	1.0	1.5	2.0
Buchaneer 5	Tenkoz	-	5	May be added*	0.8	1.2	1.6
Cornerstone	AgriSolutions (Winfield)	3	4	May be added**	1.0	1.5	2.0
Cornerstone Plus	AgriSolutions (Winfield)	3	4	May be added***	1.0	1.5	2.0
Cornerstone 5 Plus	AgriSolutions (Winfield)	4	5.5	Can be added****	0.75	1.1	1.5
Credit 4I	Nufarm	3	4	No	1.0	1.5	2.0
Credit 4I Extra	Nufarm	3	4	No	1.0	1.5	2.0
Credit Mixed Salt	Nufarm	3	3.4	May be added*	1.15	1.7	2.3
Credit Extra Mixed Salt	Nufarm	3	3.4	May be added*	1.15	1.7	2.3
Credit Duo	Nufarm	3	4	May be added*	1.0	1.5	2.0
Credit Duo Extra	Nufarm	3	4	No	1.0	1.5	2.0
Credit Systemic	Nufarm	3	4	May be added*	1.0	1.5	2.0
Credit Systemic Extra	Nufarm	3	4	No	1.0	1.5	2.0
Credit Xtreme	Nufarm	-	4.5	No	0.9	1.3	1.8
Crop-Sure Glyphosate Plus	Universal Crop Protection	3	4	May be added***	1.0	1.5	2.0
Czar	Fusion Technologies	3	4	No	1.0	1.5	2.0
Deal	Tenkoz	3	4	May be added**	1.0	1.5	2.0
Deal Plus	Tenkoz	3	4	May be added***	1.0	1.5	2.0
Debit TMF	Nufarm	4	5.4	Yes*	0.75	1.1	1.5
Durango	Dow AgroSciences	4	5.4	No	0.75	1.1	1.5
Durango DMA	Dow AgroSciences	4	5.4	No	0.75	1.1	1.5
Four Power Plus	Loveland	3	4	No	1.0	1.5	2.0
Genesis Extra	Farm Advantage	3	4	May be added**	1.0	1.5	2.0
Genesis Extra II	Farm Advantage	3	4	May be added**	1.0	1.5	2.0
Gly-4	Universal Crop Protection	3	4	May be added**	1.0	1.5	2.0
Gly-4 Plus	Universal Crop Protection	3	4	May be added***	1.0	1.5	2.0
Glycana Plus 4I	Arcana	3	4	No	1.0	1.5	2.0
Glyfine Plus	Aceto	3	4	May be added***	1.0	1.5	2.0
Glyfos	Cheminova	3	4	May be added**	1.0	1.5	2.0

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					Rate Equivalent Based on 4 lb ai/gal Product	Rate Equivalent Based on 4 lb ai/gal Product	Rate Equivalent Based on 4 lb ai/gal Product
Trade Name	Manufacturer or Distributor	Glyphosate Concentration ² Acid equivalent (a.e)	Glyphosate Concentration ² Active ingredient (a.i.)	Need for Nonionic Surfactant ³	1.0 qt	1.5 qt	2.0 qt
Glyfos X-tra	Cheminova	3	4	No	1.0	1.5	2.0
Glypho 41	UPI	3	4	May be added***	1.0	1.5	2.0
Glyphogan	Makhteshim Agan of N.A.	3	4	May be added**	1.0	1.5	2.0
Glyphomax XRT	Dow AgroSciences	4	5.4	No	0.75	1.1	1.5
Glyphosate 4	Alligare	3	4	May be added**	1.0	1.5	2.0
Glyphosate 41 Plus	CropSmart	3	4	May be added**	1.0	1.5	2.0
Glyphosate Plus	Crop-Sure	3	4	May be added***	1.0	1.5	2.0
Glyphosate 5.4	Alligare	4	5.4	Yes**	0.75	1.1	1.5
Gly Pho-Sel Pro 41%	Agrisel	3	4	No	1.0	1.5	2.0
Glysort	Glysortia	3	4	May be added**	1.0	1.5	2.0
Glysort Plus	Glysortia	3	4	No	1.0	1.5	2.0
Gly Star Gold	Albaugh	3	4	No	1.0	1.5	2.0
Gly Star Original	Albaugh	3	4	May be added**	1.0	1.5	2.0
Gly Star Plus	Albaugh	3	4	No	1.0	1.5	2.0
Gly Star Pro	Albaugh	3	4	No	1.0	1.5	2.0
GlySupreme Plus	MEY Corp.	3	4	No	1.0	1.5	2.0
Grandslam 4XS	AGRI Packaging & Logistics	3	4	May be added***	1.0	1.5	2.0
Helosate 70	Helm Agro US	4.72	6.3	May be added**	0.64	1.0	1.3
Helosate 75 SG	Helm Agro US	68.9	75	May be added**	1.3 ⁴	2.0 ⁴	2.6 ⁴
Helosate Plus	Helm Agro US	3	4	May be added**	1.0	1.5	2.0
Helosate Pro	Helm Agro US	3	4	May be added**	1.0	1.5	2.0
Honcho	Monsanto	3	4	May be added***	1.0	1.5	2.0
Honcho Plus	Monsanto	3	4	May be added***	1.0	1.5	2.0
Hoss Ultra	Helena	3	4	No	1.0	1.5	2.0
Lajj Plus	Northmoose Chemicals	3	4	No	1.0	1.5	2.0
Mad Dog	Loveland	3	4	May be added**	1.0	1.5	2.0
Mad Dog Plus	Loveland	3	4	No	1.0	1.5	2.0
Makaze	Loveland	3	4	No	1.0	1.5	2.0
Meychem 41% Glyphosate	MEY Corporation	3	4	Can be added****	1.0	1.5	2.0
Mirage	Loveland	3	4	May be added**	1.0	1.5	2.0
Mirage Plus	Loveland	3	4	No	1.0	1.5	2.0
Rascal	Winfield Solutions	3	4	May be added***	1.0	1.5	2.0
Rascal Plus	Winfield Solutions	3	4	May be added***	1.0	1.5	2.0
Rascal Plus Glyphosate 41%	Agrilience	3	4	May be added***	1.0	1.5	2.0
Reserve 41 Plus	National Ag Chem Assoc.	3	4	No	1.0	1.5	2.0

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					Rate Equivalent Based on 4 lb ai/gal Product	Rate Equivalent Based on 4 lb ai/gal Product	Rate Equivalent Based on 4 lb ai/gal Product
Trade Name	Manufacturer or Distributor	Glyphosate Concentration ² Acid equivalent (a.e)	Glyphosate Concentration ² Active ingredient (a.i.)	Need for Nonionic Surfactant ³	1.0 qt	1.5 qt	2.0 qt
Roughneck	Nufarm	3	4	No	1.0	1.5	2.0
Roundup Original	Monsanto	3	4	May be added***	1.0	1.5	2.0
Roundup OriginalMax	Monsanto	4.5	5.5	May be added*****	0.75	1.1	1.5
Roundup PowerMax	Monsanto	4.5	5.5	May be added*****	0.75	1.1	1.5
Roundup WeatherMax	Monsanto	4.5	5.5	No	0.75	1.1	1.5
StrikeOut Loaded	Libertas Now	3	4	May be added**	1.0	1.5	2.0
Tomahawk	United Suppliers	3	4	May be added*****	1.0	1.5	2.0
Tomahawk 5	United Suppliers	4	5.4	Yes***	0.75	1.1	1.5
Touchdown HiTech	Syngenta	5	--	Yes****	0.6	0.9	1.2
Touchdown Total	Syngenta	4.17	--	No	0.72	1.1	1.44
Traxion	Syngenta	4.17	--	No	0.72	1.1	1.44
Willowood Glyphosate 41%	Willowood LLC	3	4	No	1.0	1.5	2.0
Wise Up Plus	MEY Corporation	3	4	No	1.0	1.5	2.0
Z-Glyphosate 41 Max	Fusion Technologies	3	4	No	1.0	1.5	2.0

¹ Information provided by the Louisiana Department of Agriculture and Forestry through the [Pesticide Registration](#) website and the [CDMS](#) website. This list does not include all available glyphosate products. See herbicide label for specific crops and uses. The LSU AgCenter does not recommend or endorse specific herbicide brands.

² Glyphosate concentration can be expressed based on "acid equivalent" (a.e.) or on "active ingredient" (a.i.). Both concentrations usually are provided on the herbicide label. For glyphosate products, the active portion of the herbicide molecule (the part that provides weed control) is the acid. To formulate a usable and stable product, the glyphosate parent acid is attached to a salt (e.g., isopropyl amine, potassium, etc.), increasing the molecular weight of the molecule but not affecting herbicidal activity. Therefore, the a.i. designation is always a larger number.

³ Most formulations of glyphosate contain some surfactant. The need for additional surfactant is based on how much surfactant is present in the formulation and the quality of the surfactant. The herbicide label may state that no additional surfactant is needed or recommended; that surfactant may be added; or that surfactant is required and the amount is specified. It is critical that surfactant be added if required. Always consult the label for specific information on the need for surfactants and other adjuvants. For the products listed in Table 3 in regard to the need for surfactant, **No**= Label specifies that surfactant is not needed or nothing is included in reference to surfactant; **Yes**= * For surfactant at least 80 percent active, add 2 or more quarts unless otherwise indicated in specific crop or noncrop directions for using the product, ** For surfactant at least 50 percent active, add 2 or more quarts per 100 gallons water, *** For surfactant at least 70 percent active, add 2 to 4 quarts per 100 gallons water, **** For surfactant at least 75 percent active, add at 0.25 to 0.5 percent; **May be or Can be applied**= * For surfactant at least 80 percent active, add at 0.375 percent volume ** For surfactant at least 70 percent active, add at 0.5 percent volume; less than 70 percent active ingredient add at 1 percent volume, *** Use surfactant at least 70 percent active, **** Surfactant active ingredient and rate not specified, ***** Recommended when carrier volume is above 30 gallons per acre or when product application rate is less than 16 oz/A; use surfactant at least 70 percent active and add at 0.25 to 0.5 percent volume; less than 70 percent active ingredient add at 1 percent volume. Note: 0.25 percent volume = 1 qt/100 gal; 0.375 percent volume = 1.5 qt/100 gal; 0.5 percent volume = 2 qt/100 gal; 1 percent volume = 4 qt (1 gal) /100 gal.

⁴ Rate in pounds/A.

Note: For AMS (ammonium sulfate), labels for all glyphosate products state that addition of AMS may increase performance.