

PLANT GROWTH REGULATORS FOR FINE TURF

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Plant growth retardants (PGR's) or inhibitors are increasingly being used to suppress seedheads and leaf growth due to rising mowing costs and danger posed to operators and other personnel. Traditionally, plant growth retardants have been used in the South to suppress bahiagrass (*Paspalum notatum* Flugge.) or tall fescue (*Festuca arundinacea*) seedhead production exclusively in low maintenance areas such as highway roadsides, airports, and golf course roughs. However, in recent years, new chemicals which may be used in higher maintained commercial turf situations have been developed.

Several undesirable characteristics which have been associated with growth retardants include: phytotoxicity (burn) of treated leaves from 4 to 6 weeks following applications; reduced recuperative potential from physical damage to treated turf; and increased weed pressure due to reduced competition from treated turf. Normally, growth retardants are used in low maintenance areas; therefore, these undesirable characteristics do not pose a problem to most managers. However, several growth regulatory materials have recently been developed for use on hybrid bermudagrass fairways and St. Augustinegrass. Vertical topgrowth (clippings) is suppressed, but horizontal spread (runners) is not. Therefore, turf recovery from golf club divots and other injuries occurs while topgrowth remains suppressed. Other uses involve areas where mowing has been discontinued due to heavy rains, equipment failure, etc., but topgrowth remains suppressed if the grass is treated. **Note: These retardants used on hybrid bermudagrass and St. Augustinegrass do not satisfactorily suppress seedhead development.**

PGRs are separated into two groups, Type I and Type II, based on their method of growth inhibition or suppression. Type I inhibitors are primarily absorbed through the foliage and inhibit cell division and differentiation in meristematic regions. They are inhibitors of vegetative growth and interfere with seedhead development. Their growth inhibition is rapid, occurring within 4 to 10 days, and lasts 3 to 4 weeks, depending on application rate. Mefluidide, chlorflurenol, and maleic hydrazide are examples of Type I inhibitors that inhibit mitosis in growth and development. Other Type I PGRs that inhibit plant growth and development through interruption of amino acid or organic acid biosynthesis are herbicides used at low rates. Being herbicides, their margin of safety is narrow and are very rate dependent. Examples of Type I herbicide regulators include glyphosate, imidazolinones, sulfonyleureas, sethoxydim, and fluzafop.

Type II inhibitors are generally root absorbed and suppress growth through interference of gibberellic acid bio-synthesis, a hormone responsible for cell elongation. Type II PGRs are slower in growth suppression response, but their duration is usually from 4 to 7 weeks, again, depending on application rate. Type II PGRs have little effect on seedhead development and result in miniature plants. Paclobutrazol and flurprimidol are root absorbed Type II PGRs while trinexapac-ethyl is a foliar absorbed Type II PGR and is systemically translocated to the site of activity. Fenarimol is a type II fungicide that also suppresses annual bluegrass on putting greens.

Proxy 2L is a PGR with best activity on cool-season grasses. It promotes ethylene production in plants which is a regulatory hormone that restricts plant growth.

Root absorbed PGRs are activated by irrigation or rainfall after application and have less likelihood of over-lap leaf burn. Foliar absorbed materials (e.g., mefluidide, MH, and trinexapac-ethyl) require uniform and complete coverage for uniform response and must be leaf absorbed before irrigation or rainfall occurs. Usually low gallonage is used for foliar absorbed materials to minimize runoff from the leaf surface while high gallonage is used for root absorbed materials.

Timing of application for seedhead suppression is somewhat important. Applications made after seedhead emergence may not be effective. For bahiagrass, mow the area as seedheads initially emerge (usually in late May to early June) to knock down these and weeds present. Begin plant growth retardant treatment about two weeks following mowing or just prior to new seedhead appearance. Additional applications 6 to 8 weeks later may be required if new seedheads begin to emerge. A complete weed control program must accompany any plant growth retardant use. Typically, annual broadleaf weeds will become established in PGR use areas as the treated grass is not actively growing, therefore, is not providing its usual competition. Normally, 2,4-D and/or dicamba is included in this broadleaf weed control. Other postemergence herbicides such as Velpar, for grass weed control, may also be incorporated in low maintenance bahiagrass areas. The following tables list chemicals, application rates, and general remarks about each product used to suppress plant growth.

An available plant growth promoter is RyzUp from Abbott Laboratories. RyzUp is gibberellic acid which encourages cell division and elongation. When used, RyzUp helps initiate or maintain growth and prevent color changes (e.g., purpling) during periods of cold stress and light frosts on bermudagrass such as Tifdwarf and Tifgreen. Oftentimes, fall golf tournaments may experience an early light frost before the overseeding has become established. RyzUp helps the turf recover from this discoloration. PGRIV from MicroFlo is a combination of gibberellic acid and indolebutyric acid that is foliar absorbed. Research suggests this combination promotes root growth and vigor of certain plants growing under stressful conditions. Gibberellic acid containing PGRs also are used to "reverse" the inhibitory effects of Type II PGRs.

Characteristics of Plant Growth Regulators used in Fine Turf.

Active ingredient (trade name example)	Turfgrass Uses												Site of Uptake		Specific Uses			Mode of Action
	Bahiagrass	Bermudagrass	Centipedegrass	Creeping bentgrass	Fine fescues	Ky. bluegrass	Kikuyugrass	Perennial ryegrass	<i>Poa annua</i>	St. Augustinegrass	Tall fescue	Zoysiagrass	Root	Foliar	Overseeding Aid	Golf Greens	Seedhead suppression	
Ethephon (Proxy)	—	—	—	✓	✓	✓	—	✓	—	—	✓	—	—	✓	—	—	—	Promotes ethylene which reduces cell elongation
Flurprimido (Cutless)	—	✓	—	✓	—	✓	—	✓	—	✓	—	✓	✓	—	—	✓	—	Type II GA inhibitor of cell elongation
Gibberellic acid (RyzUp)	—	✓	—	—	—	—	—	—	—	—	—	—	—	✓	—	—	—	Chlorophyll (color) retention
Indolebutyric acid + gibberellic acid	—	✓	✓	✓	✓	✓	✓	✓	—	✓	✓	✓	—	✓	—	✓	—	Enhance root growth & plant vigor
Maleic hydrazide (Slo Gro)	✓	✓	—	—	✓	✓	—	✓	—	—	✓	—	—	✓	✓	—	✓	Type I growth & seedhead inhibitor
Mefluidide (Embark)	—	✓	✓	—	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	✓	—	✓	Type I growth & seedhead inhibitor
Paclobutrazol (Trimmit/TGR)	—	✓	—	✓	✓	✓	—	✓	—	✓	✓	—	✓	—	✓	✓	—	Type II GA inhibitor of cell elongation
Trinexapac-ethyl (Primo)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	✓	✓	—	Type II GA inhibitor of cell elongation
Amidochlor (Limit)	—	—	—	—	—	✓	—	✓	—	—	✓	—	✓	—	—	—	✓	Type I cell division inhibitor

Chemicals for Seedhead and Plant Growth Suppression (Refer to Herbicide Label for Specific Turf Species Use Listing)

Turf Use	Chemical Name (rate, lbs ai/acre)	Trade Names (rate, product)	Remarks
Bentgrass, Kentucky Bluegrass, Perennial Ryegrass, Tall and Fine Fescue Fairways, Roughs, and Commercial Areas	ethephon (3.4)	Proxy 2L (1.7 gal/acre or 5 fl oz/1000 ft ²)	Apply only to actively growing turfgrass not suffering heat, moisture, disease, or insect stress. Seven to 10 days are necessary for activity. Repeat applications can be made 4 weeks following the first for bentgrass and fescues & 7 weeks for Kentucky bluegrass & perennial ryegrass. Do not apply to golf greens. A spreader/sticker is not needed.
	amidochlor (2.5)	Limit 4F (0.625 gal/acre)	Root absorbed. Use on nonresidential medium to low-managed turf such as cemeteries, parks, industrial and office sites and low maintenance areas (e.g., roughs, out-of-play areas) on golf courses. Water in within 5 days of application & before mowing. May cause some yellowing. Not recommended for areas of play. Also control some broadleaf weeds.
Turfgrass Clipping Management	mefluidide (0.125 to 1.0)	Embark 2S (½ to 4 pts/15-150 gal water) Embark T&O 0.2S [5 pts (St. Augustinegrass)]	Foliar absorbed. Apply to common bermudagrass (4 pts/A Embark 2S), tall fescue & Ky. bluegrass (1½ pts/A Embark 2S), and St. Augustinegrass (Embark Lite) only. Apply in spring approximately 2 weeks before seedhead appearance. Do not apply to turf within 4 growing months after seeding. Do not water-in and do not reseed within 3 days after application. Treated turf may appear less dense and temporarily discolored. Adding 1 to 2 qts of a nonionic surfactant per 100 gal of spray solution may enhance suppression; however, discoloration may also be increased. <i>Poa annua</i> seedhead control in fairways is with ½ pt/A in early January. Iron applications may lessen discoloration. Read and follow label recommendations before use. Miscellaneous family.
	flurprimidol (¾ to 1½)	Cutless 50 WP (¾ to 3½ lb to 200 gal water or 0.28 to 1.3 oz/1,000 ft ²)	Root absorbed. Apply to bermudagrass or zoysiagrass golf course fairways, hard-to-mow and trim areas. Provides 4 to 8 week suppression. Must be uniformly applied and irrigated-in with ½ inch water. Flurprimidol does not completely control seedheads. Temporary turf discoloration may follow this treatment. St. Augustinegrass, bahiagrass, and common bermudagrass require the higher rate. Repeat applications every 4 weeks on Tifway bermudagrass with 1.0 lb/A will minimize turf injury. Do not use with SI/DMI fungicides.
	trinexapac-ethyl (0.02 to 0.086)	Primo MAXX 1EC (3 to 11 oz in 20 to 100 gal water)	Foliar absorbed. Use 3 oz/a for Tifdwarf bermudagrass greens and 6 oz/a for Tifgreen bermudagrass greens. Tifway & common bermudagrass fairways require 11 oz/a. Bermudagrass overseeding preparation requires 22 oz/a 1 to 5 days before overseeding and before verticutting, scalping, or spiking. One hour rain-free period is needed after application. Mowing 1 week after application improves results & appearance as will repeat applications in 3 to 4 weeks. Temporary turf discoloration may follow treatment. Do not add a surfactant. A 25 WSP formulation is also available. Cyclohexadione family.
	paclobutrazol (½ to 1)	TGR Turf Enhancer 50WP (1 to 1½ lb/43 to 100 gal water)	Root absorbed. Apply to well-maintained St. Augustinegrass or hybrid bermudagrass fairways. Used on overseeded golf greens during winter for turf enhancement and for annual bluegrass suppression. Do not apply to saturated soils and treat only dry foliage. Repeat applications 8 weeks apart may be made. Read & follow directions before use.

Chemicals for Seedhead and Plant Growth Suppression (Refer to Herbicide Label for Specific Turf Species Use Listing)

Turf Use	Chemical Name (rate, lbs ai/acre)	Trade Names (rate, product)	Remarks
Foliar Suppression of Overseeded Bermudagrass	mefluidide (0.125)	Embark 2S (½ pts/15-150 gal water)	Foliar absorbed. Do not apply to turf within 4 growing months after seeding, and do not reseed within 3 days after application. Treated turf may appear less dense and temporarily discolored. Adding 1 to 2 qts of a nonionic surfactant per 100 gal of spray solution may enhance suppression; however, discoloration may also be increased. <i>Poa annua</i> seedhead control in fairways is with ½ pt/A in early January. Iron applications may lessen discoloration. Read and follow label recommendations before use.
	flurprimidol (⅜ to 1½ lb)	Cutless 50W (¾ to 3 lb/50 to 200 gal water)	Root absorbed. Apply to zoysiagrass or bermudagrass in late spring-early summer and/or late summer-early fall. Time the second application at least 3 months before expected dormancy. Do not apply to putting greens. Do not exceed 1½ lb/A per application on sandy soils. Irrigate with ½ in. water & resume mowing 3 to 5 days after application. Do not use with SI/DMI fungicides.
	paclobutrazol (¼ lb)	Turf Enhancer 50 WP (½ lb/40 to 100 gal water)	Root absorbed. Repeat applications may be made 3 weeks apart. Do not use if <i>Poa annua</i> exceeds 70%. Application should be in early January.
<i>Poa annua</i> var. <i>reptans</i> (perennial biotype) Conversion/Management in Bentgrass Golf Greens	paclobutrazol (0.375)	Turf Enhancer 50 WP (0.75 lb/acre or 0.28 oz/1000ft ²)	Root absorbed. Apply 30 days apart 2 to 3 times in mid-fall (September to early Dec.) plus 2 to 3 times in very early spring (late Feb. to early May) when bentgrass is actively growing. Increased <i>Poa</i> control often occurs if a sterol inhibitor fungicide (DMI) such as Banner Maxx at 1 oz/1000 sq.ft. is applied 2 weeks following each paclobutrazol applications. Do not use if <i>Poa annua</i> populations exceed 70% as severe stand thinning or discoloration may result. Note: This program is designed as a <u>gradual transition</u> or <u>conversion</u> from <i>Poa annua</i> to bentgrass. <u>Repeat applications over several years will be required.</u> Treated <i>Poa</i> will appear noticeably lighter green in color while treated bentgrass may appear 'grainy.' It is highly recommended to start at lower rates (e.g, 8 to 12 oz/a) to ensure proper coverage and application calibration before using more aggressive rates.
		Trimmit/Turf Enhancer 2 SC (24 oz/acre or 0.55 fl.oz./1000ft ²)	
	flurprimidol (0.125 to ½)	Cutless 50W (¼ to ½ lbs/acre)	Apply in spring or in the fall. Repeat at 3 to 4 week intervals with the final application 8 weeks before winter dormancy or summer stress. Delay reseeding for 2 weeks after application.
Extending the Life of Painted Lines on Sports Fields	trinexapac-ethyl	Primo MAXX 1EC (1 oz/gallon paint) Primo 25 WSB (½ oz/gallon paint)	Used to extend the life of painted lines which reduces labor costs. The life expectancy of painted lines is extended 7 to 14 days on cool-season grasses and up to 30 days on warm-season grasses. One gallon of paint should treat approximately 1000 sq.ft. of line surface area.
Chemicals for Growth & Color Promotion of Bermudagrass such as Tifdwarf & Tifgreen	Gibberellic Acid (10 grams ai/A)	RyzUp/ProGibb 4% active solution (10 fl oz/A or 0.23 fl oz/1000 sq.ft.)	Apply 10 grams ai/acre weekly or 25 grams ai/acre biweekly in 25 to 100 GPA to promote the growth and prevent discoloration (e.g., purpling) during periods of cold stress and light frosts on bermudagrass such as Tifdwarf or Tifgreen. Do not apply when night temperatures exceed 65F. A combination product of indolebutyric acid + gibberellic acid is available as PGR IV.

Read and follow all label recommendations before use. Products listed are for use by professional turf managers only. Trade and brand names are used for information only. The South Carolina Cooperative Extension Service does not guarantee nor warrant the standard of any product mentioned; neither do they imply approval of any product to the exclusion of others which may also be suitable.

The following conversions may be useful. Gal/acre x 2.938 = oz/1000 ft²; Qt/acre x 0.7346 = oz/1000 ft²; Pint/acre x 0.3673 = oz/1000 ft²; lbs/acre x 0.02296 = lb/1000 ft².

Common and Trade Names of Speciality Use Herbicides and Plant Growth Regulators*

Common Name	Trade Name(s)
Aminopyralid	-Milestone 2L
Ammoniated soap of fatty acids	-Quick-fire, Herbicidal Soap
Asulam	-Asulox 3.34L, Asulam 3.3
Atrazine	-AAtrex, Atrazine Plus, Purge II, Aatrex 90, Atrazine 4L, Bonus S, St. Augustine Weedgrass Control + others
Benefin	-Balan 2.5G, 1.5EC, Crabgrass Preventer, + others
Benefin + oryzalin	-XL 2G
Benefin + trifluralin	-Team 2G, Crabgrass Preventer 0.92%, Team Pro
Bensulide	-Betasan, Pre-San 12.5 & 7 G, Bensumec 4L, Lescosan, Weedgrass Preventer, Betamec, Squelch, + others
Bentazon	-Basagran T/O 4L, Lescogran 4L, Nutgrass 'Nihilator
Bentazon + atrazine	-Prompt 5L, Laddock S-12
Bispyribac-sodium	-Velocity 80WP
Bromoxynil	-Buctril 2L, Brominal 4L, Bromox 2E, Moxy 2E
Cacodylic Acid	-Montar, Weed Ender
Carfentrazone	-Quicksilver 1.9 L
Carfentrazone + 2,4-D + MCPP + dicamba	-Speed Zone Southern, Speed Zone Northern and Bermuda 2.2L
Carfentrazone + MCPA + MCPP + dicamba	- Power Zone,
Chlorsulfuron	-Corsair 75DF, Telar 75DG
Clethodim	-Envoy 0.94 EC, Clethodim 2EC
Clopyralid	-Lontrel T&O 3L, Transline 3L
CMA (CAMA)	-Calar, Ortho Crabgrass Killer - Formula II, Selectrol
Corn gluten	-Dynaweed, WeedzSTOP 100G
Cytokinin	-Agridplex PGR for T&O
Dazomet	-Basamid
Dichlobenil	-Casoron 4G, Dyclomec 4G, Norosac 4G
2,4-D	-2,4-D Amine & Ester, Weedone LV4, Dacamine, Weedar 64, AM-40, 2,4-D LV4, Dymec, Lesco A-4D, + others
2,4-D + clopyralid + dicamba	-Millennium Ultra 3.75 lbs/gal
2,4-D + clopyralid + triclopyr	-Momentum, Confront 3
2,4-D + dicamba	-81 Selective Weedkiller, Four Power Plus, Triple D Lawn Weed Killer, Banvel 2,4-D

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Common Name	Trade Name(s)
2,4-D + dichlorprop (2,4-DP)	-2D + 2DP Amine, Turf D + DP, Fluid Broadleaf Weed Control, Weedone DPC Ester & Amine + others
2,4-D + dichlorprop (2,4-DP) + dicamba	-Super Trimec, Brushmaster
2,4-D + dichlorprop (2,4-DP) + MCPP	-Broadleaf Granular Herbicide, Dissolve, Triamine, Triamine Jet-Spray Triplet SF, Turf Weeder, Weed Whacker
2,4-D + mecoprop (MCPP)	-2D Amine + 2MCPP, 2 Plus 2, MCPP-2,4-D, Phenomec, Ortho Weed-B-Gon Lawn Weed Killer, Patron 170 + others
2,4-D + MCPP + 2,4-DP	-Broadleaf Granular Herbicide, Dissolve, Triamine, Tri-Ester, Jet-Spray 3-Way Weed Control, Turf Weeder + others
2,4-D + MCPP + dicamba + MCPA and/or 2,4-DP	-Trimec Southern, Three-Way Selective, Eliminate DG, 33-Plus, Dissolve, Triamine 3.9 lb/gal, TriEster, Triplet, Trex-San, Weed-B-Gon, 2 Plus 2, Bentgrass Selective Weed Killer, Trimec Bentgrass Formula, Strike 3, Broadleaf Trimec, MECamine-D, Trimec 992, Weed-B-Gon for Southern Lawns, Formula II, + others
2,4-D TIPA + MCPP + dicamba	-Triplet Low Odor
DCPA	-Dacthal W-75 WP, Dacthal 6F
Dicamba	-Vanquish 4 L, K-O-G Weed Control, Bentgrass Selective, Banvel 4S, Oracle + others
Dicamba + MCPA + MCPP	-Encore DSC, Tri-Power Dry, Tri-Power Selective, Trimec Encore
Dichlobenil	-Casoron 4G, Barrier 4G
Diclofop	-Illoxan 3EC
Diflufenzopyr + Dicamba	-Overdrive 70WG
Dikegulac-sodium	-Atrimmec
Diquat	-Reward LS, Watrol, Vegetrol, Aquatate, Aquatrim II
Dithiopyr	-Dimension 1L, Dimension Ultra 40WSP, Lifeguard, Crab and Spurge Preventer, Dimension 270-G
Diuron	-Karmex
DSMA	-Ansar, DSMA Liquid, Methar 30, Namate, DSMA 4
DSMA + 2,4-D	-Weed Beater Plus
Ethofumesate	-Prograss 1.5L
Ethephon	-Proxy 2L, Ethephon 2, ProTrim
Fenarimol	-Rubigan 1AS, Patchwork 0.78G
Fenoxaprop	-Acclaim Extra 0.57EC
Fluazifop	-Fusilade II T&O, Ornamec 170, Ornamec Over-The-Top
Fluroxypyr	-Spotlight 1.5L
Fluroxypyr + 2,4-D + dicamba	-Escalade 4.4L, Escalade2 4L
Fluroxypyr + 2,4-D TIPA + dicamba	-Escalade Low Odor 4.4L

Common and Trade Names of Speciality Use Herbicides and Plant Growth Regulators*

Common Name	Trade Name(s)
Fluroxypyr + MCPP	-Bastion T
Flurprimidol	-Cutless 50WP
Foramsulfuron	-Revolver 0.19L
Fosamine	-Krenite 4S
Gibberellic Acid	-RyzUp, ProGibb T&O
Gibberellic Acid + indolebutyric acid	-PGR IV
Glufosinate	-Finale 1L
Glyphosate	-Roundup Pro 4L, Roundup ProDry, Gly-Flo, GlyphoMate 41, Clear-Out 41 Plus, Glypro, AquaNeat, Razor Pro, Rodeo 5.4L, Kleenup Pro, Weed Wrangler, Prosecutor, Touchdown Pro, Trailblazer, Glyphomate 41 (3.8L) + others
Glyphosate + 2,4-D	-Campaign 3.1 L
Glyphosate + Diquat	-QuikPRO, Prosecutor Swift Acting
Halosulfuron	-Sedgehammer, 75WP, Sandea 75WP, Manage 75WP, Sempra 75WP
Hexazinone	-Velpar 2L
Imazapic	-Plateau 70DG
Imazapic + Glyphosate	-Journey 2.25L
Imazapyr	-Arsenal 2S
Imazaquin	-Image 1.5L, 70DF
Isoxaben	-Gallery 75DF
Isoxaben + trifluralin	-Preen 1.9G, Snapshot 2.5 TG, Gallery + Team Woodace Preen Plus
Maleic hydrazide	-Royal Slo-Gro
MCPA	-Weedar MCPA 4 lb/gal, MCPA-4 Amine + others
MCPA + clopyralid + dichlorprop	-Chaser Ultra
MCPA + clopyralid + triclopyr	-Battleship
MCPA + MCPP + dicamba	-Trimec Encore, Tri-Power, Trimec Encore DSC
MCPA + MCPP + 2,4-DP	-Triamine II, Tri-Ester II
MCPA + dicamba + triclopyr	-Eliminate, Three-Way Ester II, Horsepower 4.56 lb/gal, CoolPower 3.6 lb/gal, Clover Power, Spurge Power
MCPP	-Mecomec 4, Chickweed & Clover Control, Lescopex, MCPP-4 Amine, MCPP-4K + others
MSMA	-Daconate 6, Dal-E-Rad, Crab-E-Rad, MSMA 6.6L, Drexar 530, Buano 6L, 120 Herbicide, Daconate Super, 912 Herbicide, MSMA Turf, Summer Crabicide, Target MSMA, Weed Hoe, + others
MSMA + 2,4-D +MCPP + dicamba	-Trimec Plus (Quadmec)

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Common Name	Trade Name(s)
Mefluidide	-Embark T&O, Embark 2S, Sta-Lo
Methyl chlorflurenol	-Maintain CF
Metribuzin	-Sencor 75DF
Metolachlor	-Pennant 7.8 lb/gal, Pennant Magnum 7.62L
Metsulfuron	-Manor 60 DF, Blade 60DF, Escort 60 DF, Patriot 60 WDG, Metsulfuron Pro
Methyl Bromide	-Brom-O-Gas, Terr-O-Gas, MB 98, MBC
Napropamide	-Devrinol 50 DF, 2G, 10G, Ornamental Herbicide 5G
Napropamide + oxadiazon	-PrePair 6G
Norflurazon	-Predict
Oryzalin	-Surflan AS 4 lb/gal, Oryzalin Pro, Weed Impede, Surflan Coated Granules
Oxadiazon	-Ronstar 2G, 50WP
Oxadiazon + benefin	-Regalstar 1.5G
Oxadiazon + bensulide	-Goosegrass/Crabgrass Control 6.56G
Oxadiazon + dithiopyr	-SuperStar
Oxadiazon + pendimethalin	-Kansel + (20-2-13) 3G
Oxadiazon + prodiamine	-Regalstar II 1.2G
Oxyfluorfen	-Goal 2XL
Oxyfluorfen + oxadiazon	-OO-Herbicide 3G, Regal OO, LaSar
Oxyfluorfen + pendimethalin	-OH2
Oxyfluorfen + oryzalin	-Rout
Paclobutrazol	-Turf Enhancer 50WP, 2SC, Trimmit 2SC, TGR
Paraquat	-Gramoxone Max 3L
Pelargonic Acid	-Scythe, Quik
Pendimethalin	-Pre-M & Pendulum (60 DG, WP, 3.3EC, 2G), Pendulum AquaCap (3.8 CS), Hurdle, Turf Weedgrass Control, Halts, Corral 2.68G, ProPendi, Pendiflex 32
Picloram	-Grazon, Tordon
Prodiamine	-Barricade 65WDG, Endurance 65 WDG, Factor 65 WDG, RegalKade 0.5G & 0.37G, Stonewall, ProClipse 65WDG + others
Pronamide	-Kerb 50WP
Quinclorac	-Drive 75 DF

Common and Trade Names of Speciality Use Herbicides and Plant Growth Regulators*

Common Name	Trade Name(s)
Rimsulfuron	-TranXit GTA 25DG
Sethoxydim	-Sethoxydim G-Pro, Vantage 1.0 lb/gal, Grass Getter
Siduron	-Tupersan 50WP, 3.5%, 4.6%
Simazine	-Princep 4 lb/gal, T&O, 80WP, Simazine, Wynstar, Sim-Trol, + others
Sulfentrazone	-Dismiss Turf Herbicide 4L
Sulfentrazone + 2,4-D + MCPP + dicamba	-Surge 2.18L
Sulfometuron-methyl	-Oust 75DG, Spyder 75 DG
Sulfosulfuron	-Certainty 75WDG, Outrider 75WDG
Triclopyr	-Turflon Ester 4L, Garlon 3A (triclopyr amine), Garlon 4A (triclopyr ester), Pathfinder 1L (RTU), Tahoe 3A, Tahoe 4E
Triclopyr + 2,4-D	-Turflon II Amine, Chaser 3L Ester, Chaser 2 Amine
Triclopyr + clopyralid	-Confront 3L, Confront NR
Triclopyr + MCPP + dicamba	-3-Way Ester II
Trifloxysulfuron	-Monument 75DF
Trifluralin	-Treflan 5G, Trifluralin 4EC, Trilin 4EC, 5EC, Preen, Vegetable and Ornamental Weeder
Trifluralin + Isoxaben + Oxyfluorfen	-Showcase 2.5G
Trinexapac-ethyl	-Primo 1EC, Triple Play, Primo WSP, Primo MAXX
<i>Xanthomonas campentris</i>	-X-Po

*Refer to the herbicide label for specific site and use registration.

All chemicals mentioned are for reference only. Not all are available for turf use. Some may be restricted by some states, provinces, or federal agencies. It is advisable to check the current status of the pesticide being considered for its use. Always read and follow the manufacturer's label as registered under the Federal Insecticide, Fungicide, and Rodenticide Act. Mention of a proprietary product does not constitute a guaranty or warranty of the product by the authors or the publishers of this book and does not imply approval to the exclusion of other products that also may be suitable.

ACTIVATED CHARCOAL FOR PESTICIDE DEACTIVATION

Bert McCarty

Activated charcoal (also called activated carbon) is often used to adsorb or deactivate organic chemicals such as pesticides. Activated charcoal has been used for many years to remove organic contaminants from waste waters and in water purification systems. Since most pesticides are organic chemicals, activated charcoal can effectively be used to deactivate or “tie up” these products in soil. Once the pesticide has been adsorbed onto activated charcoal, it is biologically inactive and cannot cause injury to the turfgrass. Therefore, this product can be beneficial to turfgrass managers in the case of an accidental pesticide spill or where a herbicide needs to be inactivated for seeding or sprigging of turfgrasses. Due to its dark color, thus ability to absorb heat, activated charcoal is also used to artificially warm the soil to minimize the effects of light frosts or to allow earlier seeding of an area.

Charcoal is porous, soft, black substance made by heating in an restricted amount of air, substances containing carbon such as material from hardwood trees and coconut shells. Powdered activated charcoal is made up of very small carbon particles that have a high affinity for organic chemicals such as pesticides. Activated charcoal has a large surface area and can absorb 100 to 200 times its own weight.

The amount of activated charcoal to apply to a pesticide-contaminated area varies with the chemical characteristics of the particular pesticide. Rates generally range from about 100 to 400 pounds of activated charcoal per acre (2.3 to 9.2 pounds per thousand square feet) for each pound of active ingredient of a pesticide applied per acre. A general rule is to apply about 200 pounds of activated charcoal per acre (4.6 pounds per thousand square feet) for each pound of pesticide active ingredient per acre.

Rates of activated charcoal used for spills and deactivating turf pesticides.

Application	Recommendation	Comments
Spills	For reducing the effects from spills of organic pesticides, some petroleum products, and hydraulic fluids.	Use 100 to 400 lbs of activated charcoal to every pound of active material spilled per acre (2.3 to 9.2 lbs/1000 ft ²). If the active material has not been diluted with water at the time of spill, apply the charcoal directly as a dry power. If the active material has been diluted with water, apply the activated charcoal in a slurry with a sprinkle can or common sprayer equipment. The charcoal must be incorporated into the contaminated soil, preferably to a depth of 6 inches. With severe spills, some of the contaminated soils may need removal prior to activated charcoal application.
‘Deactivating’ turf herbicides and soil warming	Turf areas that have been treated with preemergence herbicides can be reseeded earlier than normal by treating with activated charcoal.	Whenever it is desirable to terminate a preemergence herbicide, apply charcoal slurry at a rate of 2 to 4 lbs/1000 sq.ft. Water the slurry into the soil. Make sure the grass is washed free of heavy charcoal deposits. Where possible, it is desirable to rake the charcoal into the soil thoroughly. The area can be seeded 24 hrs after treatment.

Example: Suppose Balan 2.5G was inadvertently applied at 2 pounds of active ingredient per acre to an area to be seeded with a turfgrass. To completely inactivate this herbicide, an application of activated charcoal at 400 pounds per acre (or 9.2 pounds per 1000 square feet) would be needed. See the following table for additional conversions of rates per acre to pounds per 1000 square feet.

Conversion from Pounds of Activated Charcoal Per Acre to Pounds of Activated Charcoal Per 1000 Square Feet.

Rate of Activated Charcoal (pounds per acre)	Activated Charcoal Needed (pounds per 1000 square feet)
100	2.3
200	4.6
400	9.2
800	18.4
1,600	36.7
3,200	73.5

Activated charcoal can be applied by various methods. It can be applied in the dry form with a drop spreader. However, activated charcoal particles are easily moved by wind, so it may be difficult to distribute the charcoal evenly when applied in the dry form. The easiest method is to suspend the charcoal in water and apply it by hand with a watering can (for small areas) or a power sprayer. Because activated charcoal does not mix easily with water, a 0.5 % solution of a nonionic surfactant (equivalent to 1 quart per 50 gallons) will enhance its suspension in water. Note that charcoal particles are very abrasive and can damage spray equipment (particularly rotary type pumps). Therefore, if a sprayer is used to apply activated charcoal, care should be taken to thoroughly clean the equipment when finished.

When deactivating a pesticide in a seedbed, the activated charcoal should be incorporated with a rotary tiller or other appropriate equipment so that the charcoal is placed in the upper few inches of soil. The objective is to get the activated charcoal in the same proximity as the pesticide. Uniform application of activated charcoal followed by thorough mixing is the key to inactivating a pesticide-contaminated area. If the pesticide is on the turf, in the thatch layer, or uppermost surface of the soil (for instance, if the pesticide has not been watered in), the pesticide can be inactivated by simply applying the charcoal to the area and thoroughly watering once charcoal application is complete. Again, the objective is to place the charcoal in the same proximity as the pesticide. If activated carbon is applied and either incorporated or watered correctly, inactivation of the pesticide will be successfully accomplished. For application convenience, it is recommended that activated charcoal be applied as a water slurry. To minimize dusting, always add activated charcoal to water slowly, keeping the bag as close to the water surface as possible. The following steps are suggested when mixing and applying charcoal.

Spray Application

1. Make sure spray equipment, tubing, and nozzles are completely clean. Screens should be removed if practical.
2. The final spray mixture should contain 1 to 2 lbs of charcoal per gallon of water.
3. Add sufficient water to begin moderate agitation. Simultaneously add the balance of required water and charcoal. Continue agitation until a uniform mixture is obtained.
4. Maintain moderate agitation while spraying.

It is important to understand situations where activated charcoal will not work. If a herbicide has been applied for several weeks and rainfall has occurred and/or irrigation water has been applied, the herbicide is most likely past the thatch layer and, depending on water solubility and soil adsorption of the herbicide, is probably in the upper inch or so in the soil. In this case, activated charcoal would have to be physically incorporated with a rotary tiller or other implement to get the charcoal in contact with the herbicide. The reason is activated charcoal will not leach through soil. If activated charcoal is applied to the soil surface and watered, the charcoal will remain on top of the soil and will not inactivate the herbicide below the soil surface. Activated charcoal is considered ineffective for inorganic pesticides such as arsenates, lead compounds, sodium chlorate, sulfur, borax, etc., and water-soluble organic pesticides such as, but not limited to, MSMA, and DSMA.

Activated carbon is available from most suppliers of turfgrass products. It is a good idea to keep several bags on hand so it can be applied immediately instead of having to wait for delivery. Several different brands and formulations are on the market. There appears to be little if any differences in effectiveness of the different brands. However, some may be easier to apply than others, depending on the particular situation where it is to be used.

Suppliers of activated charcoal include:

Powdered activated charcoal is available as 'Gro-Safe' from: American Norit Co., Inc. 1050 Crown Pointe Parkway Atlanta, GA 30338 1-800-641-9245	'Clean Carbon' activated charcoal is available from: Aquatrols 5 North Olney Ave. Cherry Hill, NJ 08003 1-800-257-7797
Flowable activated charcoal is available as '52 Pickup' from: Parkway Research Corp. 13802 Chrisman Road Houston, TX 77039 1-800-442-9821	

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹
Bert McCarty

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
Annual Grass and Broadleaf Weed Suppression in Dormant Bermudagrass	sulfometuron (0.047 lb)	Oust 75DG (1 oz)	Oust may be applied once in November to early-February <u>while the bermudagrass is dormant</u> for the control of winter annual grass and broadleaf weeds, and fescue suppression. This treatment may delay greenup of the bermudagrass. This treatment should eliminate the need to mow the winter weeds. It also will help to suppress bahiagrass. Sulfonylurea family.
	glyphosate (0.38 to 0.5 lb)	Roundup Pro 4L + others (12 to 16 fl oz)	Glyphosate may be applied once in January to early-March <u>while the bermudagrass is dormant</u> for the control of winter annual grass, tall fescue, and broadleaf weeds. Glyphosate does not provide residual control. Amino Acid Derivative family
	glyphosate (0.25 lb) +	glyphosate 4L (8 fl oz) +	Glyphosate and Oust may be tank-mixed to be applied once in December to early-March <u>while the bermudagrass is dormant</u> for the control of winter annual grass and broadleaf weeds. This treatment should eliminate the need to mow the winter weeds. It will also help to suppress bahiagrass. Bermudagrass greenup is not delayed extensively with this treatment.
	sulfometuron (0.012 lb)	Oust 75DG (0.25 oz)	
	glyphosate (0.25 lb) +	glyphosate 4L (8 fl oz) +	Glyphosate + Oust + Telar may be applied once in December through early-March <u>while the bermudagrass is dormant</u> for the control of winter annual grasses and broadleaf weeds. This treatment should eliminate the need to mow winter weeds. It will also help to suppress bahiagrass, and control ryegrass, mustards and thistles. Bermudagrass greenup is not extensively delayed by this treatment.
	sulfometuron (0.012 lb) +	Oust 75DG (0.25 oz) +	
	chlorsulfuron (0.012 lb)	Telar 75DG (0.25 oz)	Campaign may be applied once for the control of winter annual grass and broadleaf weeds before bermudagrass greenup. It may also suppress or control broadleaf weeds tolerant of these other treatments. Refer to the label for rates for particular species. It is not necessary to add a surfactant to Campaign. Since Campaign is a formulation containing 2,4-D, use special precautions when applying in the vicinity of 2,4-D sensitive crops such as vegetables, tobacco, fruit trees, ornamentals and cotton. Controls tall fescue, annual ryegrass, and winter annuals. Avoid application during bermudagrass greenup. Will injure green bahiagrass at these rates. Do not exceed 12 oz per acre in one year. See labeled for recommended additive. Sold only directly to governmental and educational institutions. Imidazolinone family.
	glyphosate (0.3 to 0.6 lb) +	Campaign 3.1L (1 to 2 qts) +	
	2,4-D amine (0.48 to 0.95 lb) imazapic (0.125 to 0.188 lb)	Plateau 2L (8 to 12 fl.oz.)	
	imazapic (0.091 to 0.183 lb) +	Journey 2.25 L (16 to 32 fl oz.)	
glyphosate (0.188 to 0.375 lb)		Controls tall fescue, ryegrass, winter annuals and specific perennial weeds (see SPECIAL WEED CONTROL section on label for rate for specific weed). See label for recommended tank mixes for additional weed control. A methylated seed oil concentrate at 1.5 to 2 pints per acre can be added to enhance control of specific weeds. Early spring applications made prior to full green-up may delay bermudagrass green-up.	

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
	<p>diflufenzopyr (0.05 to 0.125) + dicamba (0.1 to 0.25)</p>	<p>Overdrive 76DF (4 to 8 oz)</p>	<p>Controls annual and perennial broadleaf weeds. Add a nonionic surfactant at 0.25% v/v or methylated seed oil at 2 pts per acre to the spray mix. Diflufenzopyr often improves the activity of "auxin-like" herbicides such as triclopyr, clopyralid, and picloram. Max be tank-mixed with Garlon 4 and 3A, 2,4-D, Plateau, glyphosate, Escort, Oust, Telar, and MSMA to increase spectrum of weed species controlled. Overdrive is rainfast within 4 hours after application.</p>
Weed Control in Actively Growing Bermudagrass	<p>MSMA (2 lbs) or DSMA (3.6 lbs)</p>	<p>MSMA 6 L ($\frac{1}{3}$ gal) or DSMA 3.6 L (1 gal)</p>	<p>May be applied during summer months every 4 to 6 weeks for suppression or control of emerged weeds. This treatment will release actively growing bermudagrass and suppress bahiagrass, dallisgrass, broomsedge, johnsongrass, and several broadleaf weeds. Organic Arsenical family.</p>
	<p>diflufenzopyr (0.05 to 0.125) + dicamba (0.1 to 0.25)</p>	<p>Overdrive 76DF (4 to 8 oz)</p>	<p>Controls annual and perennial broadleaf weeds. Add a nonionic surfactant at 0.25% v/v or methylated seed oil at 2 pts per acre to the spray mix. Diflufenzopyr often improves the activity of "auxin-like" herbicides such as triclopyr, clopyralid, and picloram. Max be tank-mixed with Garlon 4 and 3A, 2,4-D, Plateau, glyphosate, Escort, Oust, Telar, and MSMA to increase spectrum of weed species controlled. Overdrive is rainfast within 4 hours after application.</p>
	<p>aminopyralid (0.06 to 0.11)</p>	<p>Milestone 2L (4 to 7 oz)</p>	<p>Controls numerous broadleaf weeds such as horseweed, dogfennel, horsenettle, and tropical soda apple. Milestone is non-volatile, but use care when applying in the vicinity of broadleaf crops, fruit trees, and ornamentals. Milestone can be tank-mixed with Plateau, glyphosate, MSMA, 2,4-D, and numerous other herbicides labeled for use on grass roadsides. Add a nonionic surfactant at 0.25% v/v to the spray mix. Pyridine family.</p>
	<p>glyphosate (0.19 to 0.3125 lb)</p>	<p>Roundup Pro 4L + others (6 to 10 fl oz)</p>	<p>May be applied during summer months to suppress or control emerged weeds and to release well-established and actively growing bermudagrass. Some discoloration of bermudagrass may occur. Do not exceed recommended rate. For bahiagrass growth and seedhead suppression, apply a second application at 4.0 fl.oz. product/acre 6 to 8 weeks after the initial application. Amino Acid Derivative family.</p>
	<p>imazapic (0.047 to 0.0625 lb)</p>	<p>Plateau 2L (3.0 to 4.0 fl oz)</p>	<p>Apply after full spring green-up of bermudagrass or during the summer months to suppress bahiagrass growth and seedhead development. Controls tall fescue, annual ryegrass, and winter annuals. Add a nonionic surfactant at 0.25% v/v or methylated seed oil at 1.5 to 2.0 pts./acre to the spray mix. Do not apply immediately before or during bermudagrass green-up. A second treatment may be applied 6 to 10 weeks for continued growth suppression. For johnsongrass control, use 8 to 12 oz per acre when plants are 18 to 24 inches tall. Tank mixing with MSMA at 2 lbs ai/acre increases the spectrum and level of weed control and often eliminates a mid-summer application and reduces turf injury. This tank mix increases control of johnsongrass and dallisgrass. Imidazolinone family.</p>

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
	imazapic (0.047 to 0.125 lb) + glyphosate (0.094 to 0.25 lb)	Journey 2.25 L (8 to 16 fl oz.)	Controls tall fescue, summer annuals and specific perennial weeds (see SPECIAL WEED CONTROL section on label for rate for specific weeds). Apply before weeds reach 6 inches in height. See label for recommended tank mixes for additional weed control. A methylated seed oil concentrate at 1.5 to 2 pints per acre can be added to enhance control of specific weeds. Some yellowing of unimproved common bermudagrass turf may occur with application during the growing season. Yellowing will usually disappear in 2 to 4 weeks under favorable weather conditions. Bahiagrass will be severely injured or controlled at these rates.
	sulfometuron (0.023lb)	Oust 75DG (0.5 oz)	Oust may be applied after full spring green-up of bermudagrass to suppress bahiagrass growth and seedhead development and for the control of certain broadleaf weeds and johnsongrass. A second treatment may be applied about 6 to 10 weeks later for continued suppression. Be certain that no bermudagrass injury is present before applying the second application. Add 2,4-D + dicamba at 1 to 2 qt/acre to increase broadleaf weed control spectrum. Provides poor control of vaseygrass, broomsedge, and dallisgrass. A nonionic surfactant at 0.25% v/v should be added to the spray mix. Sulfonylurea family.
	glyphosate (0.19 lb) + sulfometuron (0.012 lb) or MSMA (2 lb) + sulfometuron (0.012 lb)	Roundup Pro 4L + others (6 fl oz) + Oust 75DG (0.25 oz) or MSMA 6L (1/3 gal) + Oust 75 DG (0.25 oz)	Glyphosate + Oust or MSMA + Oust may be applied to bermudagrass to provide bahiagrass seedhead inhibition, vegetative suppression and johnsongrass control. Apply after full greenup of bermudagrass and bahiagrass or after the bahiagrass has been mowed. Application should be made prior to seedhead emergence. Repeat application of the glyphosate + Oust tank-mix during the growing season are not recommended. A sequential application of MSMA, or DSMA may be needed later in the summer if seedheads or weeds begin to appear. If bermudagrass is present, this treatment allows it to gradually become the dominant grass.
	metsulfuron	Escort 60DF (0.5 to 1 oz)	For bahiagrass, ryegrass, and hemp sesbania control. Add 1 qt. surfactant per 100 gal spray. Common, Argentine, & Paraguayan bahiagrass cultivars are not as susceptible as Pensacola. Also control foxtails and certain broadleaf weeds such as chickweed, clover, dandelion, plantain, purslane, spurge, woodsorrel, wild onion/garlic. Sulfonylurea family.
	glyphosate (0.3 + 0.48lb) + 2,4-D (0.45 + 0.72 lb)	Campaign 3.1L (1 to 1½ qts)	Campaign may be applied to actively growing well established bermudagrass and bahiagrass to suppress or control emerged weeds and to allow the release of the bermudagrass. Use the low rate on bahiagrass. This treatment will control many broadleaf weeds tolerant of MSMA, DSMA, glyphosate, or glyphosate + Oust due to the 2,4-D. Rate of application should be based on the weed species most common on the roadside (Refer to label). It is not necessary to add a surfactant to Campaign. Since Campaign is a formulation containing 2,4-D, use care when applying in the vicinity of 2,4-D sensitive crops such as vegetables, cotton, tobacco, fruit trees, and ornamentals.
Grass Weed Control in	imazapic (0.0625 lb)	Plateau 2L (4 fl oz)	Apply after greenup. Do not apply to drought stressed centipedegrass. Add 0.25% nonionic surfactant. Will provide suppression of many broadleaves. Imidazolinone family.

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
Centipede grass	sethoxydim (0.19 to 0.28 lb)	Vantage 1.0L (1½ to 2¼ pt)	Vantage may be applied to centipede grass roadsides to suppress most annual and perennial grasses except dallisgrass. Repeat applications will be needed to suppress bahiagrass or bermudagrass. Apply in 30 to 40 gallons of water per acre. Vantage will not suppress or control broadleaf plants which may be released due to the suppression of grassy weeds. Cyclohexendione family.
	metsulfuron (0.01 to 0.02 lb)	Escort 60DF (¼ to 1 oz)	Note the low use rate. Best control for bahiagrass. A nonionic surfactant at 0.25% by volume (1 qt/100 gal) increases control. Common, Argentine, & Paraguayan bahiagrass cultivars are not as susceptible as Pensacola. Also control foxtails and certain broadleaf weeds such as chickweed, clover, dandelion, plantain, purslane, spurge, woodsorrel, wild onion/garlic. Sulfonylurea family.
General Broadleaf Weed Control including thistles	dicamba (0.5 to 1.0 lb)	Vanquish 4S or Banvel 4S (1 to 2 pts)	Add 1 to 2 qts nonionic surfactant per 100 gal of water. Apply March through July in 20 to 40 gal water per acre as a broadcast application or 100 gal per acre as a handgun or backpack application. Add a tracker dye and drift control agent. Avoid drift especially near sensitive crops. Do not apply within the rootzone of ornamentals. Controls many broadleaf weeds including white clover, spurge, thistles, woodsorrel. Treat small (3-in) tall weeds for best control. May be tank mixed with 2,4-D, Princep, Garlon and other herbicides to broaden weed and brush control spectrum. See label for instruction. Synthetic Auxin family.
	diflufenzopyr (0.05 to 0.1) + dicamba (0.125 to 0.25)	Overdrive 70 WG 4 to 8 oz	Controls many annual, biennial broadleaf weeds and controls or suppresses many perennial broadleaf weeds. For effective thistle control, apply when in the rosette stage in spring, to early summer but before bud stage. Also controls ragweed, marehail, kochia, and prickly lettuce. A maximum of 10 ozs can be applied per season per treated acre in railroad, utility, pipeline, highway right-of-ways, and other noncropland sites. Use higher rate when treating large annuals/biennials and perennial weeds. An 80% active nonionic surfactant at 1 qt/100 gals or MSO at 1.5 to 2 pt/acre must be used to achieve consistent weed control. To complement weed spectrum or increase weed control, Overdrive can be tank mixed with various herbicides (see label for tank mix options).
	aminopyralid (0.06 to 0.11)	Milestone 2L (4 to 7 oz)	Controls numerous broadleaf weeds such as horseweed, dogfennel, horsenettle, and tropical soda apple. Milestone is non-volatile, but use care when applying in the vicinity of broadleaf crops, fruit trees, and ornamentals. Milestone can be tank-mixed with Plateau, glyphosate, MSMA, 2,4-D, and numerous other herbicides labeled for use on grass roadsides. Add a nonionic surfactant at 0.25% v/v to the spray mix.
	triclopyr (1.5 lbs)	Garlon 3A (2 qts) or Garlon 4 (1.5 qts)	Apply to actively growing plants. Add 2 to 4 qts. nonionic surfactant per 100 gals of spray. May be tank mixed with 2,4-D to broaden spectrum of weed control. Synthetic Auxin family.
	2,4-D amine (1 to 4 lb)	2,4-D amine (1 to 4 qts)	Controls most annual and perennial broadleaf weeds. Apply as a foliar spray in 30 gal water per acre to young, actively growing vegetation as a broadcast application. Add a drift control agent and be aware of nearby susceptible crops and other desirable vegetation. Synthetic Auxin family.

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
	glyphosate (0.3 to 0.6 lb) + 2,4-D amine (0.48 to 0.95 lb)	Campaign 3.1L (1 to 2 qts)	Apply prior to green-up for non-selective control of winter weeds, tall fescue, and some weeds resistant to sulfonyleurea herbicides. Add a drift control agent and be aware of nearby sensitive crops and desirable vegetation.
	clopypalid (0.28 to 0.5 lb)	Transline 3L (12 to 21 oz)	Add 1 to 2 qts of nonionic surfactant to 100 gal of solution. Apply March through early May for winter broadleaf weeds and late June to early October for summer broadleaf weeds. Apply in 20 to 40 gal water per acre as a broadcast application or 100 gal per acre as a handgun or backpack application. Add a tracker dye and drift control agent. Controls kudzu, locust, redbud, mimosa, clover, sericea lespedeza. Synthetic Auxin family.
Kudzu	clopypalid (0.5 lb)	Transline 3L (21 oz)	Used as a broadcast or spot treatment. Add 1 pt nonionic surfactant in 50 to 100 gals water. Apply during periods of active growth from June to Sept. Will also kill locust, redbud, mimosa trees, clover, sericea lespedeza. Synthetic Auxin family.
	triclopyr (see trade name rates)	Garlon 3A (1½ to 2 gal)	Amine formulation. Used as a spot or broadcast treatment. Add 1 to 2 pts surfactant per acre. Coverage should be to wet all leaves, stems, and root collars. Best control is with mid- to late-summer treatments (June to Sept).
		Garlon 4 (1 gal/100 gal solution)	Ester formulation. Used as a spot treatment in 20 to 100 gal water per acre. Add 1 to 2 qts surfactant. Best control is with mid- to late-summer treatments (June to Sept). Refer to label for application guidelines. Synthetic Auxin family.
	metsulfuron (0.045 lb)	Escort 60DF (3 to 4 oz)	Note the low use rate. Add 1 to 2 qt surfactant per 100 gal spray mix. Do not treat desirable bahiagrass. For handgun application, use 100 to 150 gal of spray mix per acre. Use 20 to 40 gal per acre for broadcast application. Thoroughly spray foliage and stems without excessive runoff. Sulfonyleurea family.
Bahiagrass Seedhead Suppression	imazapic (0.03135 to 0.0625 lb)	Plateau 2L (2 to 4 oz)	Foliar (primarily) and root absorbed. Add 1 qt/100 gal nonionic surfactant. Apply to bahiagrass in spring before seedhead formation or 7 days after mowing. Provides some broadleaf weed and nutsedge control. Do not apply to wetlands or to turf less than 3 years old. The 2 oz rate will provide partial control and minimal injury. At the 4 oz rate, treated areas may appear less dense and temporarily discolored, thus, raise the mowing height prior to this treatment. Do not use on St. Augustinegrass or drought- stress bahiagrass. Read and follow label directions before use. Imidazolinone family.
	glyphosate (0.18-0.22 lb)	Roundup Pro 4L (4 to 8 fl oz/10-25 gal water)	Foliar absorbed. Apply to bahiagrass only. Add 2 qts nonionic surfactant per 100 gals spray. Note: Glyphosate is a nonselective herbicide if applications exceed these recommended rates. Make application after full greenup of bahiagrass (timing will vary across the state). Treated areas may appear less dense and temporarily discolored. Initial application of Roundup 4L or generic glyphosate (4L) at 8 oz/A followed by 4 to 6 oz/A 6 weeks later has provided good results. Read and follow label recommendations prior to use. Amino Acid Derivative family.
	glyphosate + 2,4-D	Campaign 3.1L (16 to 24 oz/A)	

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
	sulfometuron (0.023 lb)	Oust 75 DG (½ oz/a)	Foliar absorbed. Applied after full spring green-up or 7 to 14 days after first mowing to suppress bahiagrass growth and seedhead development and for the control of certain broadleaf weeds. A second treatment may be applied about 6 to 10 weeks later for continued suppression. Often tank-mixed with Roundup or Campaign. Treated areas may appear less dense and temporarily discolored. Sulfonyleurea family.
Bahiagrass and Weed Suppression in Actively Growing Fescue	MSMA (2 lbs) or DSMA (3.6 lbs)	MSMA 6 L (1/3 gal) or DSMA 3.6 L (1 gal)	Mow roadsides, if needed, when bahiagrass or dallisgrass seedheads begin to appear (usually in early June). Begin treatment when grasses begin to send up new seedheads. Air temperature in afternoons should be 80 degrees or above. Apply as needed when new seedheads or other weeds emerge usually at 4 to 6 week intervals. Two or three applications during the summer will be needed. This treatment suppresses bahiagrass, dallisgrass, johnsongrass and broadleaf weeds and allows fescue to remain with little injury. If bermudagrass is in the roadside, fescue may be gradually replaced. Organic Arsenical family.
Tall Fescue Seedhead Suppression and Weed Control	glyphosate (0.19 to 0.25 lb) + sulfometuron (0.012 lb)	Roundup Pro 4L + others (6 to 8 fl oz) + Oust 75DG (0.25 oz)	Glyphosate + Oust may be applied to tall fescue roadsides to suppress tall fescue seedhead production. Apply to established, actively growing tall fescue in the spring <u>prior to seedhead emergence</u> (usually between March 1 and April 1). Slight discoloration of the fescue may occur. glyphosate + Oust will also help to suppress many broadleaf weeds and grasses. This treatment may eliminate the need for mowing prior to the application of summer fescue treatments that are normally made in May or June. Add 2,4-D &/or dicamba plus 1 qt/acre surfactant to improve broadleaf weed control.
	imazapic (0.0313 to 0.0625 lb)	Plateau 2L (2 to 4 oz)	Add 1 qt/100 gal nonionic surfactant to the 2 oz rate. Surfactant is not needed for the 4 oz rate. May cause temporary injury to turf and thinning of stand. Read and follow label directions before use. Imidazolinone family.
	sethoxydim (0.19 lb)	Vantage 1.0L (1.5 pt)	Vantage may be used to suppress tall fescue seedhead production. Apply to established tall fescue that is actively growing in the spring before the emergence of seedheads (usually between March 1 and April 1.) Do not apply to fescue less than one year old. Apply in 30 to 40 gallons of water per acre. Vantage will not suppress or control broadleaf plants which may be released due to the suppression of tall fescue. Discoloration of the fescue will often occur and may sometimes be severe. Cyclohexendione family.
	chlorsulfuron (0.012 lb)	Telar 75DG (0.25 oz)	Telar may be applied to suppress tall fescue seedhead production. Apply to established tall fescue that is actively growing in the spring prior to seedhead emergence (usually between March 1 and April 1). Some suppression of the grass growth may occur. This treatment will also help to suppress or control many broadleaf weeds. This treatment may eliminate the need for mowing prior to the application in the summer of MSMA or DSMA as weed control treatments in fescue. Apply in 20 to 30 gallons of water per acre. Sulfonyleurea family.
	glyphosate (0.19 to 0.25 lb) + chlorsulfuron (0.012 lb)	Roundup Pro 4L + others (6 to 8 fl oz) + Telar 75DG 0.25 oz	Glyphosate + Telar may be applied to tall fescue to suppress seedhead production and control some annual weeds. Apply to established tall fescue in the spring prior to seedhead emergence (usually between March 1 and April 1). Make only one application per season. This treatment may eliminate the need for mowing prior to the application of summer fescue treatments that are normally made in May or June. Telar provides better control of thistles and mustards than Oust.

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
	glyphosate (0.19 to 0.25) + metsulfuron (0.0094 lb)	Roundup Pro 4L + others (6 to 8 fl oz) + Escort 60 DG (0.25 oz)	Glyphosate + Escort may be applied to tall fescue to suppress seedhead production and control some annual weeds. Apply to established tall fescue in the spring prior to seedhead emergence (usually between March 1 and April 1). This treatment may eliminate the need for mowing prior to the application of summer fescue treatments that are normally made in May or June. Do not apply to mixed tall fescue/bahiagrass stands unless bahiagrass control is the desired objective.
	diflufenzopyr (0.05 to 0.125) + dicamba (0.1 to 0.25)	Overdrive 70 WG 4 to 8 ozs	Controls many annual and perennial broadleaf weeds. For effective thistle control, apply when in the rosette stage in spring, to early summer but before bud stage. Also controls ragweed, marehail, kochia, and prickly lettuce. A maximum of 10 ozs can be applied per season per treated acre in railroad, utility, pipeline, highway right-of-ways, and other noncropland sites. Use higher rate when treating large annuals/biennials and perennial weeds. An 80% active nonionic surfactant at 1 qt/100 gals or MSO at 1.5 to 2 pt/acre must be used to achieve consistent weed control. To complement weed spectrum or increase weed control, Overdrive can be tank mixed with various herbicides (see label for tank mix options) and is rainfast within 4 hours after application.
	aminopyralid (0.06 to 0.11)	Milestone 2L (4 to 7 oz)	Controls numerous broadleaf weeds such as horseweed, dogfennel, horsenettle, and tropical soda apple. Milestone is non-volatile, but use care when applying in the vicinity of broadleaf crops, fruit trees, and ornamentals. Milestone can be tank-mixed with Plateau, glyphosate, MSMA, 2,4-D, and numerous other herbicides labeled for use on grass roadsides. Add a nonionic surfactant at 0.25% v/v to the spray mix.
Limb Trimming (side trimming)	fosamine (6 to 8 lbs)	Krenite 4S (1½ to 2 gal)	Add 1 qt crop oil per 100 gal. spray solution. Only controls treated (sprayed) limbs. Best to treat in late summer (Aug, Sep, Oct). Little foliage brownout occurs after treatment. Leaves drop off the tree in a normal fashion but are not produced the following spring. Use drift control as recommended on label.
	triclopyr (1 to 2 lbs)	Garlon 4 (4 to 8 qts)	This is a dormant application (Feb., Mar., April). Apply within 10 weeks prior to normal bud break. Add 3 gal crop oil per 100 gals spray solution. Only controls treated (sprayed) limbs. Use drift control as recommended on label. Synthetic Auxin family.
Brush Control (foliar)	triclopyr (2 to 3% solution)	Garlon 3A (2 gal/100 gal solution)	Used as a spot or broadcast treatment. Add 0.25% surfactant (1 qt/100 gal). Apply during the growing season (May through Sept). Provides selective control of brush and broadleaf weeds such as blackberry, oaks, pines, sumac, and sweetgum. Also used under guardrails, fences, signs, and bridge ends. Synthetic Auxin family.
		Garlon 4 (1.5 to 3 gal/100 gal solution)	Used as a spot or if stems are too numerous for cut stump application, use as a broadcast treatment. Add 2 gal crop oil concentrate. Apply as a dormant stem and basal season applications (Feb. through April) at 3 gal/acre rate or during late summer 4 to 8 months after cutting and vegetation is actively growing (1.5 gal/acre rate). Also used under fences, culvert ends, delineators, signs, ditches (no standing water present), and bridge ends. Synthetic Auxin family.
	fosamine (6 to 12 lbs)	Krenite 4S (1½ to 3 gal)	Used as a spot or broadcast treatment. Add nonionic surfactant at 1 qt/100 gals. Use 50 gal of water per acre as a broadcast application or 100 gal water per acre as a handgun application. Thorough plant coverage is necessary for control. Best results with late summer (Aug to Oct) treatments. May be used in wetlands. Read label for details. Controls kudzu, blackberry, sumac, multiflora rose, pines, and other woody plants.

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
	glyphosate (2 to 8.1 lb)	Rodeo 5.4L ($\frac{1}{3}$ to $1\frac{1}{2}$ gal)	Used as a spot or broadcast treatment. Add 2 to 4 qts nonionic surfactant per 100 gal solution. Best results with late summer (Aug to Oct) treatments. May be used in wetlands. Thorough plant coverage is necessary for control. Also used for trimming, curbs, gutters, rip-rap, and drainage ditches. Amino Acid Derivative family.
	glyphosate (2 to 5 lb)	Roundup Pro 4L (2 to 5 qts) generic glyphosate 4L (3 to 7 pts)	Used as a spot treatment as treated grass will be damaged. Best results with late summer (Aug to Oct) treatments. Controls most annual weeds and many perennials such as johnsongrass, dock, milkweed, horsenettle, lespedeza, brambles, multiflora rose, and trumpetcreeper. Apply on a spray-to-wet basis. Grass understory will be killed at the base of the spot treatment. Use a drift control agent as recommended on the label. Add 2 to 4 qts nonionic surfactant per 100 gal solution for generic glyphosate. Amino Acid Derivative family.
	glyphosate (5%) + imazapyr (0.5%)	Roundup Pro 4L (5 gal) + Arsenal 2S (2qt/100 gal)	Apply in a low volume backpack sprayer to the point of leaf wet. Do not spray to drip. Special precaution should be followed to avoid root application in areas of desirable trees and minimize the amount of herbicide to soil contact. Weak on waxy leaf brush.
Brambles	triclopyr (see trade name rates)	Garlon 3A ($1\frac{1}{2}$ to 3 qts) Garlon 4 ($1\frac{1}{2}$ gal/100 gal solution)	Used as a spot treatment. Add 1 to 2 pts surfactant. Coverage should be to wet all leaves, stems, and root collars. Best control when applied in the spring immediately following flowering or in late summer (Aug to Nov). Used as a spot treatment in 20 to 30 gal water per acre. Add 1 to 2 pts surfactant. Treat dormant brush with most of the foliage dropped (Jan through March). Synthetic Auxin family.
	glyphosate (3 to 4 lb)	Roundup Pro 4L (3 to 4 qts)	Used as a spot treatment after plants have reached full leaf maturity. Best results with late summer (Aug to Nov) treatments. Generic glyphosate 4L may be used as a 1% solution (1 gal/100 gal spray solution). Add 2 to 4 qts nonionic surfactant per 100 gal spray for generic glyphosate. Amino Acid Derivative family.
	glyphosate (1 to 1.5% solution)	Roundup Pro 4L (1 to $1\frac{1}{2}$ gal/100 gal)	
	metsulfuron (0.023 lb)	Escort 60DF (2 oz)	Note the low use rate. Add 1 to 2 qt surfactant per 100 gal spray mix. Do not treat desirable bahiagrass. For handgun application, use 100 to 150 gal of spray mix per acre. Use 20 to 40 gal per acre for broadcast application. Controls other plants such as hemp sesbania. Thoroughly spray foliage and stems without excessive runoff. Sulfonylurea family.
Cut stump/stubble	triclopyr (see trade name rates)	Garlon 3A (4 to 6 qts) Garlon 4 (20% solution = 5 gal/100 gal)	Used as a broadcast treatment. Add $\frac{1}{4}$ to $\frac{1}{2}$ % nonionic surfactant. Best results when application is made 4 to 8 months after mowing or hand cutting and vegetation is actively growing. Use drift control. Used as a individual cut stump treatment. Add 25 gal Basal Oil per 100 gal spray. Used as a spot treatment in a squirt bottle, paint brush, or in a small hand held sprayer. Spray the root collar area, sides of the stump and the outer portion of the cut surface including cambium. Can be used on stumps for several weeks after cutting. Use a oil soluble dye. May be used year-round. May also be used during the dormant season (December through March) instead of Roundup Pro.

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
	triclopyr (1 lb)	Pathfinder II 1L (100% solution, ready to use)	Use a back-pack, squirt bottle, or small hand-held sprayer to treat individual cut stumps. Wet the area adjacent to the cambium and bark around the entire circle and the sides of cut stumps. Side stumps (suckers) should be thoroughly wetted down to the root collar area, but not to the point of runoff. Treat any time of year except when in standing water which prevents spray from reaching the ground. Synthetic Auxin family.
	imazapyr (1%)	Stalker 2L (2 qt/50 gal basal oil solution)	Add basal oil as the carrier. Treat immediately following mechanical or hand cutting. Only treat cambium region (outside 1/3 perimeter of cut stump) in a low volume backpack applicator. Imidazolinone family.
	glyphosate (50% solution)	Roundup Pro 4L (1:1 water to herbicide ratio)	Treat May through Sept immediately following cutting. Apply using a backpack sprayer or squirt bottle. Remove wood chips before application. Treat only 1/3 outside perimeter of cut stump. This is the cambium tissue where the herbicide translocates in the plant. Use a water soluble dye. No drift control agent is needed. Controls oak, sweet gum, and willow. Amino Acid Derivative family.
Injection	2,4-D amine (undiluted injection)	2,4-D amine 4EC (1 to 2 ml of concentrate per injection)	Treat May through October by making injections as near to the root collar as possible. Controls elm, popular, sassafras, willow, and many other woody species. Synthetic Auxin family.
	glyphosate (undiluted injection)	Roundup Pro 4L (1 ml of product per injection)	Inject product into base of tree every 2 to 3 inches around the trunk diameter. Applications should be made during periods of active growth. Controls oak, popular, sweetgum, and sycamore. Amino Acid Derivative family.
Bareground (1 year)	imazapyr (1.0 lb) + diuron (2.4 to 4)	Arsenal 2S (2 qts) + Karmex (3 to 5 lb)	Make broadcast applications in 40 to 50 gal of water per acre. Apply in 100 gal water per acre when using handgun. Controls many annual and perennial broadleaf and grass weeds.
	imazapyr (0.48 to 1 lb) + diuron (3.73 to 8.09 lb)	Sahara DG (6 to 13 lbs)	Tank mix with Roundup Pro for quicker control of emerged vegetation. Do not apply near roots of desirable plants.
Soil Sterilants (>2 years)	bromacil (6 to 12 lb)	Hyvar X-L (3 to 6 gal)	Apply in 100 to 200 gal of water per acre. Rainfall is required for activation. See label for specific recommendations and weeds controlled.
	bromacil (2.4 to 12 lb) + diuron (2.4 to 12 lb)	Krovar I DF (6 to 30 lbs)	Apply prior to weed emergence. If small weeds exist at time of application, add 1 qt nonionic surfactant per 100 gal of spray solution. Rainfall will be needed to carry herbicide into the root zone of weeds. The length of weed control will be extended as rate is increased. See label for specific recommendations and weeds controlled.

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
Johnsongrass in bermudagrass	imazapic (0.188 to 0.375 lb)	Plateau 70DG (4 to 8 oz) or Plateau 2S (8 to 12 oz)	Add 1 qt nonionic surfactant in 100 gals of spray solution. Apply in 20 to 40 gal per acre. Treat from May to Aug when plants are 18 to 24 inches tall. Controls johnsongrass, crabgrass, ragweed, sandspur, ragweed, tall fescue, prickly sida, trumpetcreeper. Use higher rate for later season treatment. To increase control, add MSMA at 2 lbs ai per acre. Do not mow prior to treatment or within 14 days after treatment. Imidazolinone family.
	imazapic (0.123 to 0.183 lb) + glyphosate (0.246 to 0.375 lb)	Journey 2.25 L (21 to 32 fl oz.)	Apply when johnsongrass has reached 18 to 24 inches in height at the whorl. Use higher rate as density increases. Also controls smutgrass, dallisgrass, bahiagrass, vaseygrass and other <i>Paspalum</i> spp. For best results, use a MSO at 1.5 to 2 pts/acre.
	asulam (3.3 to 6.7 lb)	Asulox 3.34L (1 to 2 gal)	Broadcast treatment when grass is 18 inches or taller. Use higher rate in heavy infestations. A nonionic surfactant can be added at 0.25% by volume. DO NOT TREAT DESIRABLE CENTIPEDEGRASS.
	glyphosate (0.25 to 1% solution)	Roundup Pro 4L (¼ to 1 gal/100 gal)	Used as a spot treatment after plants have reached 12 to 18 inches in height. Best results with summer (June to Aug) treatments. Use higher rate with larger plants. Will cause temporary discoloration and result in turf thinning.
	glyphosate (0.5 to 3 lb) See Remarks	Roundup Pro 4L (0.5 to 3 qts) See Remarks	Used as a broadcast treatment. Use 1 pt/acre for burndown of smaller plants up to 12 inches tall. Use 2 to 3 qt/acre for larger plants in the boot to head stage. Best results with summer (June to Aug) treatments. Generic glyphosate 4L may also be used as a 0.75% solution (3 qts/100 gal spray) as a spot treatment. Use 3 to 4.5 pts/acre for broadcast treatment. Add 2 to 4 qts nonionic surfactant per 100 gal spray. Treat only actively growing plants (June through September). Will cause temporary discoloration and result in turf thinning.
	glyphosate (0.5 to 0.75 lb) + sulfometuron (0.047 to 0.09 lb)	Roundup Pro 4L (16 to 24 fl oz) + Oust 75DG (1 to 2 oz)	Apply after full greenup of bermudagrass and is actively growing. Repeat application of this tank-mix during the growing season is not recommended. Expect 2 to 4 weeks damage to the bermudagrass. A sequential application of Roundup Pro, MSMA, or DSMA may be needed later in the summer if weeds begin to appear. If bermudagrass is sporadically present, this treatment allows it to gradually become the dominant grass. Apply in 20 to 40 gal water per acre. Do not mow prior to treatment or within 14 days after treatment. Expected control is 80 to 85 % with low rates and 90 to 95% at the high rate.
	MSMA (2 lb) or DSMA (3.6 lb)	MSMA 6 L (⅓ gal) or DSMA 3.6 L (1 gal)	May be applied April through August every 4 to 6 weeks for suppression or control of emerged weeds. Two to 3 applications may be needed for control. Apply in 40 gal per acre. This treatment will release actively growing bermudagrass and suppress bahiagrass, dallisgrass, johnsongrass, and several broadleaf weeds. Treat when johnsongrass is 12 to 18 in-tall. Tank mixing with Oust at 1 oz/acre during the first treatment will help provide preemergence seedling johnsongrass control. Do not add Oust to subsequent treatments.
	sulfosulfuron (0.035 to 0.062 lb)	Outrider 75 DF (0.75 to 1.33 oz)	Excellent (85 to 95%) for johnsongrass control in bermudagrass. To increase weed control spectrum, add Roundup Pro at 12 to 24 fl oz/acre or MSMA 6L at 3.3 to 4 pts/acre. Add 0.5% nonionic surfactant (2 qts/100 gal spray) or methylated seed oil if Roundup Pro is not used. Treat May through July when plants are small and temperatures above 80F. Sulfonylurea family.

VEGETATION MANAGEMENT AND WEED CONTROL IN SPECIALTY TURF AREAS SUCH AS ROADSIDES, INDUSTRIAL SITES, FIELDS, COMMON AREAS¹

SITE/WEED	COMMON NAME (lbs ai/acre)	TRADE NAMES (rate of product/acre)	REMARKS AND PRECAUTIONS (Always Use Drift Control as Recommended by Each Herbicide Label)
Ryegrass	prodiamine (0.65 to 1.5 lbs)	Endurance 65DF (1 to 2.3 lb)	These preemergence herbicides must be applied prior to ryegrass germination, usually by mid-Sept. Tank mix with glyphosate for control of emerged plants in bahiagrass.
	pendimethalin (2 to 4 lb)	Pendulum 60DF (3.3 to 6.6 lb)	
	metsulfuron (0.019 to 0.045 lb)	Escort 60DF (0.5 to 2 oz)	Note the low use rate. Best to apply when ryegrass is immature (Nov. to early Jan.). Do not treat desirable bahiagrass. Sulfonylurea family.
	sulfometuron (0.04 to 0.09 lb)	Oust 75DF (1 to 2 oz)	Do not add surfactant. Controls winter annual broadleaf weeds, ryegrass, fescue, and suppresses early summer annuals. Fall applications compared to later applications, permit earlier spring green-up of bermudagrass. Sulfonylurea family.
	glyphosate (0.3 + 0.6 lb) + 2,4-D (0.48 + 0.95 lb)	Campaign 3.1L (1 to 2 qts)	Apply to dormant bermudagrass before March. High rate is needed unless ammonium sulfate (AMS) is added. With this combination, use Campaign at 1 qt/acre + AMS at 17 lbs per 100 gal of carrier. Apply in 20 to 40 gal water per acre. It is not necessary to add a surfactant to Campaign. Treat small weeds (<6-in tall) for best results. Since Campaign is a formulation containing 2,4-D, use care when applying in the vicinity of 2,4-D sensitive crops such as vegetables, cotton, tobacco, fruit trees, and ornamentals. Control is slow (2 to 4 weeks). Use appropriate drift control agent.
	glyphosate (0.25 lb) + sulfometuron (0.012 lb) + chlorsulfuron (0.012 lb)	Roundup Pro 4L (8 fl oz) + Oust 75DG (0.25 oz) + Telar 75DG (0.25 oz)	Do not use on desirable bahiagrass or tall fescue. Should be used from late Dec through early March for control of annual grasses and broadleaf weeds including mustards and thistles. Roundup Pro can be used alone or tank mixed with Oust and Telar for better control of broadleaf weeds. Bermudagrass greenup is not extensively delayed by this treatment.

Note: In portions of the United States, numerous weed species have developed resistance to members of the sulfonylurea herbicide family (e.g. Telar, Oust, Escort). Resistant biotypes are able to survive rates several times higher than needed to control susceptible biotypes. Roadside managers are encouraged to follow these weed control practices to prevent sulfonylurea resistant weeds. (1) Tank mix sulfonylurea herbicides with herbicides that have a different mode-of-action (e.g. Roundup, 2,4-D, etc.). (2) Do not let weed escapes go to seed in areas treated with sulfonylurea herbicide. (3) Respray problem areas with a herbicide that has a different mode-of-action than a sulfonylurea. (4) Rotate the use of sulfonylurea herbicides with herbicides that have a different mode-of-action. Imidazolinone herbicides have the same mode-of-action as sulfonylureas.

¹Spray equipment must be properly calibrated. A digital speed monitoring device helps maintain the correct ground speed of an application vehicle instead of relying on its stock speedometer. Spray pattern width should be continually monitored throughout the application. Spray pattern bending (distortion) because of excessive ground speeds (≥ 13 MPH) or wind will shorten spray widths and cause over-application.

²Most herbicides should not be treated to drought stressed turf. Excessive turf damage and reduced weed control often results.

SPRAY ADDITIVES

Product	Description	Trade Name Examples
Acidifier	Add to spray mix to lower pH.	PAS-800; Monterey Super 7; pHazol
Activator	Enhances activity of pesticide by enabling improved plant absorption	Surf-King Plus; Delux, Microyl, Pen-A-Trade, Persist, Speed
Buffer	Stabilizes tank mix pH and makes it more resistant (buffer) to changes	No Foam A/B, BS-500; Surf-King Plus; Adjust, Buffer-Ten; New Balance
Colorant (dye)	Adds color to spray mix to aid in spray pattern detection	Blazon; Blue Dye; Grass Greenzit; Finn Green Plus; Gordon's Spray Colorant; H ₂ O Blue; Mark-It Blue/Green/or Red; Red Dye; Signal; Signal Blue EZ Solupak; Signal Green EZ Solupak; Super Signal Blue/Green
Conditioning Agent	Water-softening agent for hard water	Perc-O-Late; Duke; Spary-Start; Spectra Max Tank Mix; N-pHURIC GTO; PAL
Compatibility Agent	Aids in even distribution of incompatible products in a spray tank	MIX; Coblend ES; Compex; Convert
Crop Oil	Petroleum-based oils that increase spray penetration through plant leaf cuticle. Methylated seed oils (MSO) are plant-based crop oils.	CMR Herbicide Activator; Hygrade EC; JLB Oil Plus Peptoil, Primary; Majestic; Monterey MSO; Crop Oil Concentrate; Persist Ultra; Sunwet
Defoaming/Anti-foaming Agent	Minimizes foaming in the spray tank	Defoamer; NO FOAM A/B; Foam Buster; Fome-Kil; Concentrated Defoamer; Anti-Foam; Ultra 90-NF; Knockdown
Drift-Control Agent (or thickeners)	Reduces spray drift by increasing spray droplet size	AMS Supreme; LOX; Bridle; Confine; Gravity; Ground Zero; STA-PUT; Jetwet DC; Nalco-Tro; Exactrol; MORE; Detain II; Border EG 250; Direct; SANAG 38-F; SANAG 41-A
Spreader/Sticker	An adjuvant that lowers water surface tension and increases spray droplet adherence to the leaf surface	ClearSpray T/O; CMR Silicone Surfactant; Pirene II; Surf-King; Bio-Film; Rocket DL; Ultra 90-NF; Umbrella; Silicone Super Wetter; Jetwet; Chem-Stik
Sticker/Deposition Agent	Increases adhesion (rain fastness) of spray droplet on plant surface	AMS Supreme; LOX; LOX Plus; Bind-It'
Surfactant/Spreader/Wetting Agent	Surface-active agents that improves the emulsifying; dispersing, spreading, wetting or other properties of a liquid by modifying its surface characteristics. Wetting agent is a type of surfactant that improves the ability of water to penetrate water-repellent soils, thus, increases infiltration rates. Non-ionic surfactants do not ionize, thus, remain uncharged. These are unaffected by high water levels of Ca, Mg, or ferric ions and can be used in strong acid solutions.	Agri-Dex; Aquabond; Aquatrols; Aqueduct; Alleviate; Aquabond; Brilliance; Lesco Flow/Wet; Cascade; Cascade Plus; Cohort DC; Dispatch; Duplex; Dura Wet; Genepol 26-L-80; Hydro-Wet; Induce-F; Infiltrix; Jaf-Pynt; Jetwet HL; Magnify; PsiMATRIC; EcoWet; Dura-Wet (Naiad); Long-Term; Magic-Wet; Magnus; Monterey AgResources; NoburnN; Pene-Turf; Precision EZ Tabs; Primer Select; Oasys Ultra; Rely/Rewet; Renex-30; Rocket DL; Short-Term; Sil-Fact; Surf AC820/910; Surf Side 37A; Sixteen 90; Thoroughbred; Timberland 90Torpedo; Tournament-Ready; X-77
Tank Cleaner	Cleans pesticide and fertilizer residues from spray tanks	Tank Cleaner; CMR Pesticide Equipment Cleaner; Tank Cleaner; Tank Cleaner Dry Formulation; K-Klean Liquid Tank and Equipment Cleaner; Incide-Out
Thickener	Increases the viscosity of the spray droplet to reduce evaporation and allow more time for leaf absorption	Bridle; Confine; Gravity; First Watch Mosquito Larvicide & Pupacide; Jetwet DC

Guide to Woody Plant Response to Herbicides*

Herbicides	Ash	Birch	Blackberry	Cedar	Dogwood	Elm	Greenbrier	Hawthorn	Hickory	Honey Locust	Honeysuckle	Kudzu	Maple	Mulberry	Multiflora Rose	Oaks	Persimmon	Pines	Poison Ivy	Poplar	Sassafras	Sumac	Sweetgum	Sycamore	Trumpet Creeper	Willow
2,4-D amine (FS)	P	F	F	P	P	F	P	F	F	P	P	P	P	P	P	F	P	P	P	F	P	F	P	F	P	P
2,4-D amine (CS)	P	F	P	P	F	G	P	F	F	F	P	P	P	F	P	F	F	F	F	G	G	F	F	F	F	G
2,4-D ester (FS)	P	-	P	P	P	P	P	-	P	P	P	P	P	P	P	P	P	P	P	-	P	F	P	-	P	P
Arsenal (FS)	G	G	P	P	G	P	P	G	G	P	G	P	G	G	G	G	F	P	G	F	G	G	G	G	G	G
Banvel (FS)	P	-	F	F	F	F	P	F	P	P	F	G	P	-	F	F	G	G	F	-	F	F	F	-	F	F
Crossbow (FS)	F	F	G	P	P	F	P	F	F	F	P	P	F	P	F	F	F	F	F	F	F	G	F	F	P	F
Escort (FS)	F	P	G	P	F	F	P	P	P	G	G	G	F	P	F	F	P	P	P	P	P	P	P	P	P	P
Garlon 3A (FS)	F	F	G	P	F	F	P	F	F	F	P	F	F	F	F	G	F	G	F	F	F	G	G	F	P	F
Garlon 4 (CS)	F	F	P	F	F	F	P	F	F	F	P	F	G	F	F	G	F	F	G	F	F	G	G	F	P	F
Garlon 4 (FS)	F	F	G	F	F	F	P	F	F	F	P	F	F	F	F	G	F	G	F	F	F	G	G	F	P	F
Garlon 4 (BS)	F	F	G	F	G	F	P	F	G	F	P	F	G	F	F	G	F	G	P	F	F	G	G	F	P	F
Krenite (FS)	F	F	F	P	F	F	P	P	P	F	F	G	F	F	F	F	F	G	P	F	P	F	F	F	F	F
Pathway	F	F	P	F	F	F	P	F	F	F	F	P	F	P	P	F	F	G	P	P	P	P	F	P	P	P
Roundup Pro (FS)	F	F	F	P	P	F	P	F	P	P	F	F	P	P	F	G	F	P	F	F	P	F	F	P	F	F
Roundup Pro (CS)	F	F	F	F	F	F	P	F	F	F	F	P	F	F	P	G	F	G	G	F	F	F	G	G	P	F
Weedmaster (FS)	P	F	F	P	P	P	P	F	P	P	F	P	P	P	P	P	F	F	F	F	P	F	P	F	F	P
Transline (FS)	-	-	-	-	-	-	-	-	-	G	-	G	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*G = Good
FS = Foliar Spray

F = Fair (partial control or defoliation)
BS = Basal Soil or Cut-Surface Spray only

P = Poor - = no data available
CS = Cut Surface