

Weed Control in Seashore Paspalum: Herbicide Selection and Resistance Management

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Seashore paspalum (*Paspalum vaginatum* (Sw.)) is a warm-season turfgrass planted in coastal, tropical, and warm temperate regions generally between 0 to 30-35° N-S latitude for golf courses, lawns, and recreational turf. Compared to other turfgrasses, seashore paspalum has superior broad-based tolerance to salinity, acidic soils, soil types, and irrigation with salt-laden alternative water. Weed control is often a major challenge in seashore paspalum management due to excessive injury from many herbicides. Caution is also needed when using many herbicide chemistries that may not have been tested thoroughly on seashore paspalum or researched under coastal environments. This limits the potential for selective control of many weeds in paspalum and the mechanisms of action available for chemical resistance management. Turf managers have fewer tools for weed control in seashore paspalum compared to bermudagrass (*Cynodon* spp.) or other warm-season turfgrasses. This publication was created to summarize weed control options in seashore paspalum with an emphasis on herbicide selection and chemical resistance management.

Preemergence Herbicides

Microtubule disruptors. The dinitroanilines (DNAs, Group 3) are widely used for preemergence control of annual grassy and broadleaf weeds in turfgrass. The DNA herbicides include **pendimethalin** (Pendulum, others), **prodiamine** (Barricade, others), and **oryzalin** (Surflan). These herbicides are relatively cheap, broad spectrum, and safe to use on established seashore paspalum. Dimension (**dithiopyr**) and Kerb (**pronamide**) are also Group 3 herbicides that provide preemergence weed control in seashore paspalum. These herbicides inhibit cell division from a different site of action than the DNAs. Dimension provides preemergence control of crabgrass (*Digitaria* spp.), annual bluegrass (*Poa annua*), and annual broadleaf weeds such as common lespedeza (*Kummerowia striata*) and spurge (*Euphorbia* spp.). Kerb is primarily used for pre- and early postemergence control of annual bluegrass in seashore paspalum during the late Fall, but can provide selective control of perennial ryegrass (*Lolium perenne*) and other grassy weeds.

Chlorophyll synthesis inhibitors. Ronstar (**oxadiazon**) provides preemergence control of grassy weeds through the inhibition of chlorophyll biosynthesis (Group 14). It is labeled for nonresidential turf only and provides excellent control of crabgrass, goosegrass (*Eleusine indica*), annual sedges (*Cyperus* spp.), and other annual grassy weeds. A limitation to Ronstar use in seashore paspalum is application uniformity. The sprayable formulations (Ronstar Flo, others) injure actively growing paspalum turf and discoloration may persist for several weeks. The granular formulations have less potential to injure seashore paspalum than sprayables, but application uniformity may be more difficult to achieve. The Ronstar 2G is a very fine granule that should be applied with limited interference from high winds. Mixing the granular oxadiazon with a fertilizer carrier improves the application uniformity and distribution. Some type of cultivation (i.e., spiking, slicing) is recommended when applying the granular formulation in order to minimize particle migration.

Dismiss (**sulfentrazone**) is also a Group 14 herbicide that provides preemergence control of sedges, kyllinga, seedling goosegrass, and certain broadleaf weeds. It can be applied to residential and nonresidential seashore paspalum. Sulfentrazone is also sold in combination with prodiamine (Echelon) for enhancing the control spectrum of preemergence grassy weeds compared to Dismiss alone. Seashore paspalum managers can use sulfentrazone-containing products in sequential applications in a summer annual weed control program. These scheduled applications are more effective in targeting weeds that emerge later than crabgrass, such as goosegrass and annual sedge (*Cyperus compressus*). Sulfentrazone also has early-postemergence efficacy and may provide end-users with greater application timing flexibility during the Spring.

Cellulose biosynthesis inhibitors. Specticle Flo (**indaziflam**) should be used only during the Fall for preemergence annual bluegrass control in seashore paspalum. This herbicide inhibits cellulose biosynthesis in susceptible weeds and provides an alternative mode of action to the DNA herbicides. Seashore paspalum has exhibited significant injury from Specticle Flo use during the late Winter and prior to Spring greenup as well as emerging from environmental stress during the root recovery process. In coastal areas, there is significant bioavailability of indaziflam in sandy soils with low organic matter for turfgrass uptake, which can result in paspalum damage. Later Winter applications are also a period when seashore paspalum has limited root growth, which may exacerbate injury potential during Spring transition and enhanced regenerative root growth.

Specticle Flo must be applied at low application rates (3 to 4.5 fl oz/acre) in a sequential program during the Fall to maximize selectivity in seashore paspalum. Do not apply Specticle Flo for the initial preemergence application in late Winter for summer annual weeds in seashore paspalum due to Spring injury potential.

Gallery (**isoxaben**) is another cellulose biosynthesis inhibitor for preemergence control of annual broadleaf weeds. It provides good control of spurge, chamberbitter (*Phyllanthus urinaria*), henbit (*Lamium amplexicaule*), and other broadleaf weeds, but does not control most common grassy weeds in turfgrass. Gallery may be tank-mixed with DNAs or other preemergence herbicides to enhance the spectrum of weeds controlled.

Cell division inhibitors. Tower (**dimethenamid**) is a Group 15 preemergence herbicide for annual sedges, doveweed (*Murdannia nudiflora*), goosegrass, and many annual broadleaf weeds. It disrupts several aspects of growth in susceptible weeds including lipid synthesis and cell division inhibition. Seashore paspalum managers can use Tower in sequential applications following dinitroaniline herbicides applied for preemergence grassy weed control in late Winter. Tower has short residual control (4 to 6 weeks) at labeled rates and may require multiple applications during the growing season. Freehand is a combination product that contains dimethenamid with the DNA herbicide, pendimethalin. This combination may provide broad-spectrum preemergence control of grassy weeds, sedges, and broadleaf weeds.

Postemergence herbicides

Acetolactate synthase (ALS)-inhibitors. The ALS-inhibitors (Group 2) are postemergence herbicides for controlling grasses, broadleaf weeds, and sedges. These herbicides disrupt branched-chain amino acid synthesis in susceptible species. Katana (**flazasulfuron**), Sedgehammer (**halosulfuron**), Certainty (**sulfosulfuron**), Defendor (**florasulam**), and Image (**imazaquin**) are ALS-inhibitors that control sedges and broadleaf weeds selectively in seashore paspalum. Katana controls cool-season grasses including annual bluegrass and ryegrass, along with many annual broadleaf weeds. Metsulfuron (Manor, MSM, others) is a popular herbicide for controlling annual and perennial broadleaf weeds such as common lespedeza and spurge. It also provides selective control of bahiagrass (*Paspalum notatum*) and ryegrass in seashore paspalum. Certainty, Image, and Sedgehammer are primarily used for controlling sedges and kyllinga in seashore paspalum, but also control several broadleaf weeds. Defendor is an ALS-inhibitor that controls broadleaf weeds with limited activity on grasses.

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Photosystem II inhibitors. Xonerate (**amicarbazone**) is a Photosystem II (PS-II) inhibitor (Group 5) herbicide, similar to the triazines. The disruption of photosynthesis results in free radical damage to cell membranes in susceptible weed species. Seashore paspalum has superior tolerance to Xonerate compared to other PS II-inhibitors, such as atrazine or simazine. Xonerate may be applied during spring transition or after greenup to seashore paspalum. It controls annual bluegrass and many broadleaf weeds commonly found in turf. Xonerate may also be applied in combinations or sequential programs with Dismiss for controlling tropical signalgrass (*Urochloa subquadriflora*) in seashore paspalum. Basagran (**bentazon**) is also an inhibitor of photosynthesis. It is a contact herbicide (not systemically translocated) that provides rapid control of sedges and broadleaf weeds. Basagran effectively controls seedling broadleaf weeds, but requires sequential applications for controlling sedges.

Synthetic auxins. The synthetic auxin herbicides (Group 4) provide selective postemergence control of broadleaf weeds in seashore paspalum. These herbicides include the growth regulators 2,4-D, dicamba, and MCPP. Other auxin herbicides that may be used in seashore paspalum include fluroxypyr and clopyralid. These herbicides disrupt cell division by mimicking the auxin hormone, resulting in uncontrolled growth in susceptible weeds.

2,4-D is one of the oldest and most widely used herbicides for broadleaf weed control in turf. 2,4-D provides broad-spectrum weed control in turfgrass and is particularly effective for control of weeds with taproots like common dandelion (*Taraxacum officinale*) and buckhorn plantain (*Plantago lanceolata*). Amine formulations are most commonly used, but the low volatile ester is often recommended for control of wild garlic (*Allium vineale*) and wild onion (*Allium canadense*). **MCPA** is chemically-related to 2,4-D and may be used as a substitute for 2,4-D in prepackaged mixtures. MCPA is not a broad-spectrum herbicide like 2,4-D and use alone (i.e., not mixed with another herbicide) is not usually recommended. **MCP** is most effective in the control of several perennial and winter annual weeds such as clovers and chickweed.

Clopyralid is a non-phenoxy herbicide sold as Lontrel for nonresidential turf. It provides broad-spectrum control of broadleaf weeds including lespedeza, clover (*Trifolium* spp.), and yellow woodsorrel (*Oxalis stricta*). **Quinclorac** (Drive, others) controls white clover (*Trifolium repens*) and other broadleaf weeds, but the primary use of quinclorac in seashore paspalum is postemergence crabgrass control. Quinclorac is also found in mixture products including Q4, One-Time, and Solitaire.

Lipid synthesis inhibitors. **Ethofumesate** (Prograss, others) is labeled at low use rates in seashore paspalum for controlling annual bluegrass, bermudagrass, and other weeds. It inhibits lipid synthesis in susceptible weeds. Research has shown that seashore paspalum absorbs less ethofumesate than bermudagrass that is associated with the differential tolerance levels. Turfgrass managers primarily use ethofumesate in combination with **flurprimidol** (Cutless, others) for bermudagrass suppression. Sequential applications of ethofumesate in the Fall provide early postemergence control of annual bluegrass and other winter annual weeds.

Carotenoid biosynthesis inhibitors. **Topramezone** (Pylex) is a postemergence herbicide for crabgrass and goosegrass control. The mode of action for Pylex is a HPPD-inhibitor or inhibition of carotenoid biosynthesis. Susceptible weeds exhibit bleaching symptoms (whitening) from this mode of action that will persist for 7 to 14 days after treatment. Seashore paspalum is susceptible to injury from Pylex that may persist for two to three weeks. This injury includes discoloration and stunted growth.



Problem Weed Control and Resistance Management

Herbicide resistance has been identified in many common weeds of seashore paspalum including spotted spurge, annual sedge, annual bluegrass, goosegrass, and crabgrass. Herbicide resistance occurs from the repeated use of the same herbicide or mode of action over time that shifts the weed population. As susceptible biotypes are controlled, the resistant biotypes survive and reproduce. This type of selection pressure leads to the spread of resistant plants that become the dominant biotype in the weed population.

Herbicide resistance will impact the long-term sustainability of seashore paspalum management due to the limited number of selective herbicides available for weed control. Seashore paspalum managers can proactively plan rotation programs that include various herbicide modes of action in combinations or sequential applications. This approach along with sound cultural practices will delay the development of herbicide resistance and improve the efficacy of weed control programs.

Annual bluegrass. Preemergence herbicides applied in Fall may prevent annual bluegrass establishment in seashore paspalum. Dinitroaniline (DNA) herbicides are widely used for preemergence control of annual bluegrass in turf. However, the exclusive use of DNA herbicides over the years has led to the spread of resistant biotypes. **Dithiopyr** (Dimension) is a pyridine herbicide that inhibits mitosis at a different site



of action than the DNAs. Annual bluegrass with resistance to DNA herbicides has also shown cross-resistance to Dimension. Therefore, it is recommended that turf managers select other herbicides for controlling annual bluegrass if DNA-resistance is a concern.

Pronamide (Kerb) provides pre- and postemergence control of annual bluegrass in seashore paspalum (Table 1). Kerb is a mitotic inhibitor (Group 3 herbicide) that must be absorbed by roots. It is critical that applications receive rainfall or irrigation within 24 hours to maximize efficacy. Although Kerb is a mitotic inhibitor, it has a different site of action than the DNA herbicides. In Georgia, Kerb provides effective preemergence control of annual bluegrass with resistance to DNA-herbicides and Dimension (dithiopyr). Kerb should be applied at 1 to 1.5 lb of active ingredient per acre by early December. A concern with pronamide is the potential for lateral movement to susceptible (cool-season) turfgrasses. Applicators should avoid treatments on slopes or to saturated soils if cool-season grasses are adjacent to targeted application areas.

Ronstar 2G (**oxadiazon**) and Bensumec 4L (**bensulide**) offer alternative modes of action to the DNAs for preemergence control of annual bluegrass in seashore paspalum (Table 1). These active ingredients are found in the combination product Anderson's Goose and Crab. Oxadiazon and bensulide often provide erratic levels of annual bluegrass control, but provide an alternative mode of action for rotation programs with other preemergence herbicides. **Ethofumesate** (Prograss 1.5EC, others) also provides preemergence control of annual bluegrass in seashore paspalum, but labeled rates may not provide season-long control compared to higher rates for other turf species. Two applications of ethofumesate at a four week interval beginning in late Fall can control annual bluegrass seedlings and provide residual control during periods of peak germination.

Turf managers should consider using Specticle Flo 0.62L (**indaziflam**) in seashore paspalum as an alternative to DNA herbicides (Table 1). It has a different mode of action than the DNA herbicides (cellulose biosynthesis inhibition) for pre- and early postemergence control of annual bluegrass. In coastal areas, Specticle Flo should be applied to seashore paspalum prior to annual bluegrass germination at 3 to 4 fl oz of product per acre. It should only be used on established turfgrasses under optimal growing conditions. Specticle has some risk for turf injury on sandy soils with low organic matter and turfgrass ecosystems that are stressed which results in paspalum reverting to root regeneration. Adjusting the rate or making split applications can reduce potential turfgrass injury from these treatments.

The sulfonylureas (acetolactate synthase inhibitors, ALS-inhibitors) and triazines (Photosystem, PS II inhibitors) are widely used for postemergence control of annual bluegrass in warm-season grasses (Table 2). **Flazasulfuron** (Katana) and **imazaquin** (Image) are the only ALS-inhibitors labeled for seashore paspalum with efficacy for annual bluegrass control. Katana can be applied at 1 to 1.5 oz/acre in late November or December to seedling annual bluegrass. Rates and timing of applications are critical management issues for the sulfonylurea herbicides in paspalum. This recommended application timing is when annual bluegrass is most susceptible to control, and the residual Katana application can prevent the establishment of new seedlings during peak periods of germination. Image (**imazaquin**) generally is not as effective as Katana for annual bluegrass control, but a similar application program could be used in late Fall for early postemergence control. Do not apply these herbicides in late Winter or during Spring transition to seashore paspalum, especially when paspalum is in the root regeneration mode and recovering from stress. Severe injury or delays in greenup may occur at rates required to control annual bluegrass at these scheduled applications.

Xonerate (**amicarbazone**) provides selective postemergence control of annual bluegrass and is the only PS-II inhibitor safe for seashore paspalum. (Table 2) Seashore paspalum has good tolerance to Xonerate in Winter and during Spring transition. Turf managers may apply Xonerate 70WG from 4 to 8 oz/acre in seashore paspalum for annual bluegrass. Sequential treatments with lower rates at a two to three week interval may be required for controlling annual bluegrass in the Spring. New formulations of Xonerate are available from FMC with different active ingredient concentrations. See labels for application instructions and rates for seashore paspalum.



Segregation of annual bluegrass biotypes after a sulfonylurea application indicating resistance.

Crabgrass and Goosegrass. Turf managers may use dinitroaniline (Group 3 herbicides), **indaziflam** (Specticle Flo), or **oxadiazon** (Ronstar) in seashore paspalum (Table 1). Dinitroaniline (DNA) herbicides and Dimension (**dithiopyr**) are widely used for preemergence control of crabgrass. These herbicides generally provide erratic levels of goosegrass control. Specticle Flo and Ronstar effectively control crabgrass and goosegrass, but have significant limitations for use in seashore paspalum. Specticle Flo may cause excessive turf injury when applied at high rates (5 fl oz/acre or higher) on soils with low (<1%) organic matter. Seashore paspalum is most susceptible to indaziflam injury in late Winter and Specticle Flo is not recommended for the initial application in a sequential program when paspalum is in the root regeneration and recovery mode after stress. Ronstar must be applied in a granular formulation during active growth due to excessive injury potential from sprayable applications. These limitations, along with herbicide costs, may present challenges to controlling these annual grassy weeds.



Quinclorac (Drive, others) is the active ingredient in Drive and numerous combination products (ex. Q4 Plus, OneTime, Solitare, others) that provides postemergence control of crabgrass (Table 2). Quinclorac should be applied at 0.75 lb of active ingredient per acre with a crop oil or methylated seed oil adjuvant. Quinclorac is most efficacious on crabgrass that is in the 1 to 2-tiller growth stage or younger, and repeated applications will be required to control multi-tiller crabgrass in the Summer. Quinclorac does not control goosegrass.

Dimension 2EW (**dithiopyr**) can provide early-postemergence crabgrass control in seashore paspalum. Dimension must be applied to seedling crabgrass for best results. Applications to tillered crabgrass provide erratic levels of postemergence control in early Summer. Areas treated with Dimension should receive irrigation within 24 hours to minimize losses through volatilization in late Spring or Summer.

There are limited herbicides available for postemergence goosegrass control in seashore paspalum. **Sulfentrazone** is an active ingredient found in Dismiss, Dismiss South, Dismiss NXT, Solitare, and other combination products. It is a chlorophyll synthesis inhibitor that provides early-postemergence control of seedling goosegrass. However, sulfentrazone does not control established goosegrass in a single application and tank-mix partners are recommended to improve efficacy. Reduced application rates have shown good selectivity for goosegrass control on golf greens but are currently not a labeled recommendation.

Pylex (**topramezone**) provides excellent postemergence control of goosegrass in centipedegrass, tall fescue, and other tolerant species (Table 2). However, seashore paspalum is susceptible to injury from Pylex at labeled rates for these grasses. Applications of Pylex at reduced rates of 0.5 to 0.75 fl oz per acre are labeled for seashore paspalum golf course fairways. Pylex will temporarily injure seashore paspalum for two to three weeks from excessive bleaching (whitening of leaves). Seashore paspalum generally recovers under good growing conditions with comparable or better green color to the area prior to treatments. End-users should include a crop oil adjuvant with treatments, and monitor areas for regrowth after approximately three weeks to determine if a sequential application is needed.

Sedge and Kyllinga. Seashore paspalum managers have several pre- and postemergence herbicides for controlling sedges and kyllinga (Tables 1 and 2). The ALS-inhibitors (Group 2) are the most efficacious herbicides in seashore paspalum. These herbicides include **halosulfuron** (Sedgehammer, others), **imazaquin** (Image), **flazasulfuron** (Katana), and **sulfosulfuron** (Certainty). They are systemically translocated and take about three weeks to completely control sedges and kyllinga. These applications should include a non-ionic surfactant at 0.25% v/v to enhance foliar uptake and make repeat applications after four to six weeks if needed. Basagran (**bentazon**) is an alternative mode of action (Group 5) chemistry to the ALS-inhibitors for controlling sedges in paspalum. It provides faster control responses in sedges than Group 2 herbicides, but requires at least two applications at a two to three week interval. Basagran needs to be applied at 1.5 to 2 pints per acre with an adjuvant to maximize foliar uptake.

Dismiss (**sulfentrazone**), Dismiss South (**sulfentrazone + imazethapyr**), and Dismiss NXT (**sulfentrazone + carfentrazone**) provide rapid postemergence control of many sedge and kyllinga species. Sulfentrazone is a Group 14 herbicide (chlorophyll synthesis inhibitor) with fast postemergence activity on sedges. It also provides 6 to 8 weeks of preemergence control of annual sedges, annual kyllinga, and yellow nutsedge (*Cyperus esculentus*). Sulfentrazone generally provides more consistent control of sedges than Basagran and has an important use for resistance management.

Turf managers have used halosulfuron and other ALS-inhibitors (Group 2 herbicides) exclusively for postemergence control of sedges for decades and resistant populations have been identified in turfgrass. There are currently six sedge species with reported ALS-resistance including annual sedge (*Cyperus compressus*) from turfgrass. It is recommended that paspalum managers continue using Group 2 herbicides in tank-mixtures with alternative modes of action, including sulfentrazone and bentazon. Applying two modes of action will prevent that spread of resistant biotypes to one of the active ingredients while controlling the susceptible population. A recommended tank-mixture to delay resistance in sedge populations would be Dismiss at 10 fl oz/acre + Sedgehammer at 1 oz/acre.

Preemergence control of annual sedge and kyllinga may be achieved with sulfentrazone (Dismiss) alone or in combination with prodiamine (Echelon). Echelon is recommended as the sequential treatment in a preemergence crabgrass control program by following the initial application of a dinitroaniline herbicide, such as prodiamine or pendimethalin. The sequential treatment of Echelon after 6 to 8 weeks will extend the residual control of grassy weeds, and control sedges that emerge later in the Spring with warmer soil temperatures compared to crabgrass. The sulfentrazone component of the Echelon product also provides some postemergence control of sedges that may have emerged, while providing greater application timing flexibility to end-users.



Another preemergence herbicide to consider for sedge control in seashore paspalum is **dimethenamid** (Tower). This is a Group 15 herbicide that also controls broadleaf weeds, doveweed, and goosegrass. Like sulfentrazone, dimethenamid is also found in a combination product with a dinitroaniline herbicide for use at the sequential application timing of a preemergence crabgrass control program. Tower has shorter soil residual activity than sulfentrazone at labeled use rates, and repeat applications may be needed after four to six weeks. Dismiss and Tower can provide partial control or suppression of perennials, such as green kyllinga (*K. brevifolia*) or yellow nutsedge, but these herbicides do not provide preemergence control of purple nutsedge. The use of dimethenamid or sulfentrazone alone or in combinations with postemergence herbicides will be the best strategy to enhance sedge control and delay resistance development.

Bermudagrass. Seashore paspalum is often unable to outcompete with bermudagrass growth during Summer months. Preemergence herbicide use is generally not a practical approach to controlling bermudagrass in mature turfgrasses. Preemergence herbicides have potential to injure stolons of bermudagrass bordering seashore paspalum (i.e. dinitroanilines) and delay encroachment. However, turf managers should not rely on efficacy of these herbicides for long-term bermudagrass control.

Seashore paspalum has good tolerance to moderate rates of **ethofumesate** (PoaConstrictor, Prograss), which may be used in combination with **flurprimidol (Cutless)** to control bermudagrass (Table 2). Ethofumesate is a Group 8 herbicide that has postemergence activity for grassy and broadleaf weed control in nonresidential turf. Spot treatments of nonselective herbicides are the most effective method in controlling bermudagrass. **Glyphosate** is a nonselective herbicide that is widely used for spot treatments of perennial weeds in turfgrasses. Glyphosate is a foliar absorbed herbicide that is systemically translocated with no preemergence activity for weed control. Glyphosate inhibits 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) in the shikimic acid pathway, blocking the production of aromatic amino acids: phenylalanine, tyrosine, and tryptophan.

Spot treatments of glyphosate should be made to bermudagrass patches and surrounding areas to control any stolons that may be intermingled with desirable turfgrasses. Broadcast applications can effectively renovate or kill existing vegetation, but high rates and multiple applications are required to control bermudagrass (Table 2). Glyphosate should be applied to actively growing bermudagrass and repeat treatments will be required for potential complete control. Cultural practices that disrupt plant growth such as vertical mowing and aerification, should be delayed for seven days after treatment.

Glyphosate requires optimum translocation in order to control bermudagrass rhizomes and plants emerging from lateral stems. Perennial grasses generally have greater translocation of photosynthates from leaves to stems during the Fall than in the Spring, which increases glyphosate movement to rhizomes. Fall glyphosate applications generally control bermudagrass more effectively than Summer treatments. Numerous glyphosate products are available under a wide variety of trade names. See product labels for rates and mixing instructions for spot treatments of glyphosate for postemergence bermudagrass control.

Spurge. Some of the most difficult broadleaf weeds to control in seashore paspalum are spurge species. Spurges are highly branched annuals that germinate when soil temperatures reach the 70°s F. Plants form a taproot, produce hundreds of seed, and secrete a milky sap when shoots are crushed. **Metsulfuron** (Manor, MSM) at 0.25 oz/acre has been one of the most effective treatments for spurge control in seashore paspalum. This treatment is very selective and cheap for end-users. However, resistance to metsulfuron and other ALS-inhibitors has been confirmed in spotted spurge (*Euphorbia maculata*). Superintendents will need to plan control programs with alternative herbicides to metsulfuron for sustainable management.

Most synthetic auxins (Group 4) that are safe in seashore paspalum provide erratic control of spurge. **Dicamba** and **MCPA** are the most effective synthetic auxins for spurge control. These active ingredients are often found in combination products with 2,4-D and other broadleaf herbicides in formulated mixtures like Trimec, Triplet, and Weed B Gone. Xonerate (**amicarbazone**) is a Group 5 (Photosystem II inhibitor) herbicide that provides an alternative mode of action to metsulfuron for spurge control. It provides rapid control of many annual broadleaf weeds. Turf managers can tank-mix these herbicides with metsulfuron to enhance the spectrum of weeds controlled and delay the resistance development to single modes of action in spurge populations.

Dismiss (**sulfentrazone**) can provide early postemergence control of spurge, but it is not a standalone herbicide after plants begin branching. Tank-mixtures of Dismiss with dicamba or metsulfuron can enhance the postemergence activity of these herbicides in seashore paspalum to provide faster control than exclusive treatments. Dismiss provides some residual control of spurge, but will not provide season-long preemergence control.



Gallery (**isoxaben**) provides excellent preemergence spurge control. It is a different mode of action (Group 21) than most preemergence herbicides used in seashore paspalum. Gallery has poor activity on crabgrass and most grassy weeds, but can be tank-mixed with dinitroanilines for increasing the control spectrum of weeds. Tower (**dimethenamid**) provides short-term preemergence control of spurge at labeled application rates (20 to 32 fl oz/acre). Sod growers utilize Tower for spurge control because it does not restrict lateral rooting of seashore paspalum during establishment. Dimethenamid is also found in a combination product with a dinitroaniline herbicide (Freehand) for use at the sequential application timing of a preemergence crabgrass control program. Multiple applications of Tower will be needed every four to six weeks for season-long control of spurge in seashore paspalum. Tank-mixtures with postemergence herbicides will improve preventative programs for spurge by controlling seedlings and providing residual control.

Tropical signalgrass. Seashore paspalum grown in coastal environments may have tropical signalgrass invasion over time. It is a warm-season perennial with a coarse leaf texture and competitive growth with turfgrasses. Tropical signalgrass establishing from seed can be controlled in seashore paspalum with preemergence herbicides including the dinitroanilines (**pendimethalin, prodiamine**), Echelon (**prodiamine + sulfentrazone**) Dimension (**dithiopyr**), or granular Ronstar (**oxadiazon**). However, populations that overwinter in a vegetative state will emerge from belowground stems rather than seed. These plants are not controlled by preemergence herbicides and thus, postemergence options are needed.



Seashore paspalum is susceptible to injury from most postemergence herbicides that control tropical signalgrass selectively in bermudagrass. Turfgrass managers have had success using Xonerate (**amicarbazone**) alone or in sequential programs with Dismiss South (**sulfentrazone + imazethapyr**). Fall is the best time of year to optimize herbicide efficacy for long-term tropical signalgrass control. Plants will translocate herbicides more readily to belowground rhizomes in fall, compared to spring, that will enhance potential for long-term control with postemergence herbicides. Spring herbicide applications can provide significant suppression of tropical signalgrass to reduce the spread of infestations. The initial treatments should be made after tropical signalgrass has resumed active growth in the Spring with sequential applications on a three to four week schedule. Other options include hand-weeding or spot treatments of glyphosate followed by salt applications to enhance desiccation of the tropical signalgrass in seashore paspalum. *((Note: some superintendents are using Solitare with pre- and post-applications of salt, which starts desiccation on the weed and allows more chemical penetration into the plant; some are also adding crop oil adjuvants))*



Herbicides with Severe Injury Potential on Seashore Paspalum

Turf managers should **NOT make broadcast applications** of the following herbicides on seashore paspalum due to severe injury potential: MSMA, triclopyr, diclofop, fenoxaprop, fluazifop, sethoxydim, atrazine, simazine, metribuzin, foramsulfuron (Revolver), trifloxysulfuron (Monument), Tribute Total, and Celsius.

Table 1. Preemergence herbicides for use in seashore paspalum.

WSSA Group ^a	Common Name	Trade Names	Application Rates (per acre)	Comments
3	dithiopyr	Dimension 2EW, others	0.25 to 0.5 lb ai	Controls grassy weeds, several broadleaf weeds, and provides early-postemergence crabgrass control
	pendimethalin	Pendulum AquaCap, others	1.5 to 3 lb ai	Controls grassy weeds and selected broadleaf weeds.
	prodiamine	Barricade, others	0.5 to 0.75 lb ai	Controls grassy weeds and selected broadleaf weeds.
	pronamide	Kerb 3.3SC	0.75 to 1.5 lb ai	Provides pre- and early postemergence control of annual bluegrass and other grassy weeds. Make initial applications in late November/early December for annual bluegrass control .
3 + 14	prodiamine + sulfentrazone	Echelon 4SC	18 to 36 fl oz	Controls annual grasses, certain annual broadleaf weeds, annual sedges, kyllinga, and yellow nutsedge. Do not apply to newly installed sod until the grass has rooted. Do not apply on golf greens.
14	oxadiazon	Ronstar 2G	1 to 3 lb ai	Controls annual grassy weeds, annual sedges, and some broadleaf weeds
	sulfentrazone	Dismiss 4SC	8 to 12 fl oz	Provides preemergence control of annual sedges, kyllinga, broadleaf weeds, and goosegrass.
15	dimethenamid	Tower	20 to 32 fl oz	Controls annual sedges, doveweed, goosegrass, and annual broadleaf weeds.
15 + 3	dimethenamid + pendimethalin	FreeHand	100 to 200 lb	Controls grassy weeds, annual sedges, doveweed, and annual broadleaf weeds.
16	ethofumesate	Prograss 1.5EC	1/3 gal	Provides pre- and early postemergence control of annual bluegrass and other grassy weeds. Make multiple applications on 14 to 21 day interval for bermudagrass suppression.
21	isoxaben	Gallery 75WG	0.67 to 1.33 lb	Controls broadleaf weeds including spurge, henbit, chickweed, and lespedeza.
29	indaziflam	Specticle Flo	3 to 4.5 fl oz	Controls annual grassy weeds including annual bluegrass, crabgrass, goosegrass, annual sedges, and broadleaf weeds

^aWSSA groups: 3 = microtubule assembly inhibition, 14 = Protoporphyrinogen oxidase (PPO) inhibition, 15 = inhibition of cell division, 16 = Lipid synthesis inhibition (non-ACCase), 21 = cellulose biosynthesis inhibition, 29 = cellulose biosynthesis inhibition.

Table 2. Postemergence herbicides for use in seashore paspalum.

WSSA Group ^a	Common Name	Trade Names	Application Rates (per acre)	Comments
2	flazasulfuron	Katana 25WG	1 to 2 oz	Apply in late fall for early-postemergence control of annual bluegrass and annual broadleaf weeds. DO NOT apply to seashore paspalum during spring transition. Applications in summer may control sedges, kyllinga, broadleaf weeds. Apply with a surfactant at 0.25% vol/vol.
	florasulam	Defendor 0.42 lb/gal	4 fl oz	Controls annual and perennial broadleaf weeds in established turf including residential lawns, golf courses, sports fields, non-residential lawns, and sod farms. Apply with a non-ionic surfactant at 0.25% vol/vol. Do not apply to golf greens or more than 12 oz/acre per year.
	halosulfuron	Sedgehammer, others	1 to 1.3 oz	Controls annual broadleaf weeds, annual and perennial sedges, and kyllinga. Apply with a surfactant at 0.25% vol/vol.
	imazaquin	Image 70DG	8.6 to 11.4 oz	Controls annual broadleaf weeds, annual and perennial sedges, and kyllinga. Apply with a surfactant at 0.25% vol/vol.
	metsulfuron	Manor, MSM, others	0.25 to 0.5 oz	Controls bahiagrass and broadleaf weeds including spurge, lespedeza, and pennywort. Apply with a surfactant at 0.25% vol/vol. Avoid use during spring transition or during recovery from stress.
	sulfosulfuron	Certainty 75WG	1 to 1.67 oz	Controls tall fescue, roughstalk bluegrass, annual broadleaf weeds, annual and perennial sedges, and kyllinga. Apply with a surfactant at 0.25% vol/vol.

2 + 4 + 14	penoxsulam + sulfentrazone + 2,4-D + dicamba	Avenue South	3 to 6 pints	Controls annual and perennial broadleaf weeds in established turf including residential lawns, golf courses, sports fields, non-residential lawns, and sod farms. Do not use clippings from treated areas as mulch.
3	dithiopyr	Dimension 2EW, others	0.5 lb ai	Controls seedling crabgrass up to a 1 to 2-tiller stage. Make applications with a non-ionic surfactant at 0.25% vol/vol.
	pronamide	Kerb 3.3 SC	0.75 to 1.5 lb ai	Controls annual bluegrass in late fall or early winter. Treated areas must receive irrigation within 24 hours to soil incorporation for root uptake.
4	2,4-D 4L	Various	0.5 to 1 qt	Controls annual and perennial broadleaf weeds.
	2,4-D + dicamba + MCPP	Trimec, Triplet, others	See label	Controls annual and perennial broadleaf weeds. Do not apply to paspalum under stress from heat, disease, or pests.
	dicamba	Banvel 4L, others	0.5 to 1 pt	Controls annual and perennial broadleaf weeds including spurge, lespedeza, and buttonweed.
	quinclorac	Drive, others	0.75 lb ai	Controls crabgrass, barnyardgrass, and broadleaf weeds. Apply after paspalum has resumed active growth after spring transition. Make applications with a crop oil or methylated seed oil at 0.5 to 1% vol/vol.

4 + 14	2,4-D + dicamba + MCPA + carfentrazone	Speedzone Southern	2 to 5 pt	Controls annual and perennial broadleaf weeds. May be applied after four weeks of sprigging or sodding. Do not apply when air temperatures are above 90° F.
5	amicarbazone	Xonerate 70WG	3 to 10 oz	Controls annual bluegrass, spurge, tropical signalgrass, and winter annual weeds. Make repeat applications of lower rates at a 14 to 21-day interval.
		Xonerate 2SC	9 to 14 fl oz	
6	bentazon	Basagran T & O	1.5 to 2 pt/acre	Controls annual broadleaf weeds and sedges in seashore paspalum. Two applications may be required for controlling perennial sedges in summer.
14	carfentrazone	Quicksilver 1.9 lb/gal	0.8 to 2.1 fl oz	Controls seedling broadleaf weeds and moss. Add a non-ionic surfactant at 0.25% vol/vol.
	sulfentrazone	Dismiss 4SC	8 to 12 fl oz	Controls seedling goosegrass, annual broadleaf weeds, annual sedge, yellow nutsedge, and annual kyllinga. Do not apply to seashore paspalum under stress from heat, disease, or other stresses.
	sulfentrazone + carfentrazone	Dismiss NXT	10 to 15 fl oz	
14 + 2	sulfentrazone + imazethapyr	Dismiss South	9.5 to 14.4 fl oz	Controls seedling goosegrass, annual broadleaf weeds, annual sedge, yellow nutsedge, tropical signalgrass, and kyllinga. Do not apply to seashore paspalum under severe stress.
14 + 4	sulfentrazone + quinclorac	Solitare 75WG	16 to 32 oz	Controls crabgrass, barnyardgrass, seedling goosegrass, annual broadleaf weeds, annual sedge, yellow nutsedge, and annual kyllinga. Do not apply to seashore paspalum under stress from heat, disease, or other stresses.

16	ethofumesate	Prograss 1.5EC	1/3 gal	Provides early postemergence control of annual bluegrass and other grassy weeds. Applications will suppress bermudagrass alone or in tank-mixtures with Cutless (flurprimidol).
27	topramezone	Pylex	0.5 to 0.75 oz/acre	Apply for postemergence control of crabgrass and goosegrass in seashore paspalum. Pylex will cause severe bleaching (whitening) of seashore paspalum for two to three weeks. Only apply if injury and growth inhibition can be tolerated. Use a methylated seed oil at 0.5% v/v to improve efficacy. Tank-mixtures with chelated iron can reduce turf discoloration from Pylex.

^aWSSA groups: 2 = acetolactate synthase (ALS) inhibition, 3 = microtubule assembly inhibition, 4 = synthetic auxins, 5 = Photosystem II inhibition, 6 = Photosystem II inhibition, 14 = Protoporphyrinogen oxidase (PPO) inhibition, 16 = Lipid synthesis inhibition (non-ACCase).

Table 3. Herbicide examples for problem weed control in seashore paspalum with alternative herbicides with different mechanisms of action.

Weed	Timing	Herbicide	Alternative mechanism of action
Annual bluegrass	PRE	Dinitroanilines	Specticle, Ronstar, Katana (early POST), Kerb (early POST)
		Specticle	Dinitroanilines, Dimension, Ronstar, Katana (early POST), Kerb (early POST)
		Dimension	Specticle, Ronstar, Katana (early POST), Kerb (early POST)
		Ronstar	Specticle, Dimension, Dinitroanilines, Katana (early POST), Kerb (early POST)
		Kerb	Specticle, Ronstar, Katana (early POST)
	POST	Katana	Kerb, Xonerate
		Kerb	Katana, Xonerate
		Xonerate	Katana, Kerb
Annual sedges and kyllinga	PRE	Tower	Dismiss, Echelon
		Dismiss	Tower, Freehand
		Echelon	Tower, Freehand
		Freehand	Dismiss, Echelon
	POST	Sedgehammer	Basagran, Dismiss
		Basagran	Dismiss, Certainty, Katana, Sedgehammer, Image
		Certainty	Basagran, Dismiss
		Dismiss	Basagran, Certainty, Katana, Sedgehammer, Image
		Image	Basagran, Dismiss
		Katana	Basagran, Dismiss
Crabgrass	PRE	Dinitroanilines	Specticle, Ronstar
		Specticle	Dinitroanilines, Ronstar, Echelon, Freehand, Dimension
		Ronstar	Specticle, Dinitroanilines, Dimension, Echelon, Freehand
		Echelon	Specticle, Ronstar
		Dimension	Specticle, Ronstar
	POST	Dimension	Drive, Pylex
		Drive	Dimension, Pylex

Goosegrass	PRE	Pylex	Drive, Dimension
		Dinitroanilines	Specticle, Ronstar, Tower, Dismiss, Echelon, Freehand
		Specticle	Dinitroanilines, Ronstar, Tower, Dismiss, Echelon, Freehand
		Ronstar	Specticle, Dinitroanilines, Tower, Dismiss, Echelon, Freehand
		Tower	Specticle, Ronstar, Dinitroanilines, Dismiss, Echelon
		Echelon	Specticle, Ronstar, Tower, Dinitroanilines, Freehand
		Dismiss	Specticle, Ronstar, Tower, Dinitroanilines, Freehand
	POST	Pylex	Dismiss
		Dismiss	Pylex
Spurge	PRE	Tower	Dismiss, Echelon, Gallery
		Dismiss	Tower, Freehand, Gallery
		Echelon	Tower, Freehand, Gallery
		Freehand	Dismiss, Echelon, Gallery
		Gallery	Tower, Freehand, Dismiss, Echelon
	POST	Manor	Dicamba, MCPA
		Dicamba	Manor
		MCPA	Manor
Tropical Signalgrass	PRE	Dinitroanilines	Specticle, Ronstar
		Specticle	Dinitroanilines, Dimension, Ronstar
		Dimension	Specticle, Ronstar
		Ronstar	Specticle, Dimension, Dinitroanilines
	POST	Dismiss South	Xonerate
		Xonerate	Dismiss South

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Table 4. Seashore paspalum tolerance to herbicides. Abbreviations: T = tolerant, I = intermediate at low use rates

Herbicide	Tolerance	Registered for	
		Paspalum	Trade Name (Examples)
2,4-D	T	Yes	Weedar, Harball, Dymec, others
2,4-D + clopyralid + dicamba	T	No	Millenium Ultra
2,4-D + dicamba + MCPP	T	Yes	Trimec Southern, Triplet, others
2,4-D + dicamba + MCPP + carfentrazone	T	Yes	Speedzone Southern
2,4-D + dicamba + MCPP + sulfentrazone	T	No	Surge
2,4-D + dicamba + penoxsulam + sulfentrazone	T	Yes	Avenue South
2,4-D + dicamba + quinclorac + sulfentrazone	I-T	No	Q4 Plus
amicarbazone	T	Yes	Xonerate
benefin	T	No	Balan, others
benefin + trifluralin	T	No	Team
bensulide	T	Yes	Bensumec, Bensulide
bentazon	T	Yes	Basagran, others
bromoxynil	T	No	Buctril, others
carfentrazone	T	Yes	Quicksilver
clopyralid	T	Yes	Lontrel
dicamba	T	Yes	Banvel, Vanquish, others
dimethenamid	T	Yes	Tower
dimethenamid + pendimethalin	T	Yes	Freehand
flazasulfuron	I-T	Yes	Katana
florasulam	T	Yes	Defendor
halosulfuron	T	Yes	Sedgehammer, Prosedge, others
imazaquin	I-T	Yes	Image
indaziflam	I	Yes	Specticle Flo

isoxaben	T	No	Gallery
MCPP	T	Yes	Mecoprop, others
metsulfuron	T	No	Manor, MSM, others
oxadiazon	T	Yes	Ronstar 2G, Oxadiazon, others
oxadiazon + prodiamine	T	No	Regalstar II
pendimethalin	T	No	Pendulum, Pre-M, others
prodiamine	T	Yes	Barricade, others
prodiamine + sulfentrazone	T	Yes	Echelon
pronamide	T	No	Kerb
quinclorac	T	Yes	Drive, Drive XLR8, others
siduron	T	No	Tupersan
sulfentrazone	T	Yes	Dismiss
sulfentrazone + imazethapyr	T	Yes	Dismiss South
sulfentrazone + carfentrazone	T	Yes	Dismiss NXT
sulfentrazone + quinclorac	T	Yes	Solitare
sulfosulfuron	T	Yes	Certainty
topramezone	I	Yes	Pylex
