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 rotation. This publication was created to summarize weed control options in seashore paspalum with an emphasis on herbicide selection and resistance management.

Preemergence Herbicides

Microtubule assembly inhibitors. 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. 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 paspalum.

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. The sprayable formulations (Ronstar Flo, others) can be applied before planting sod or sprigs but severe injury may occur from applications to actively growing paspalum turf.

The spreadable Ronstar formulations have less potential to injure seashore paspalum than sprayables, but application uniformity may be more difficult to achieve. The Ronstar 2G is a fine granule that should be applied with limited interference from high winds. Mixing oxadiazon with a fertilizer carrier improves the application uniformity and distribution.

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 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.

Cell division inhibitors. Tower (**dimethenamid**) and StriCore (**pethoxamid**) are Group 15 preemergence herbicides that control annual sedges, doveweed (*Murdannia nudiflora*), goosegrass, and many annual broadleaf weeds. These herbicides disrupt several aspects of growth in susceptible weeds including lipid synthesis and cell division inhibition. Seashore paspalum managers can use Tower in sequential applications following DNA 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 in paspalum.

Cellulose biosynthesis inhibitors. Specticle Flo (**indaziflam**) is a preemergence herbicide that can control goosegrass, annual bluegrass, and many other annual weeds. Paspalum managers need to reduce application rates of Specticle to no more than 3 fl oz/acre on sandy soils with low organic matter (1% or less) to reduce injury potential. Sequential applications at 6 to 8-week intervals, or rotations with other chemistries, will be required to extend residual control of problem 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**), Image (**imazaquin**), and Arkon (**pyrimisulfan**) are ALS-inhibitors that control sedges and broadleaf weeds selectively in seashore paspalum. Katana controls cool-season grasses including annual bluegrass and perennial 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. Aethon is a combination product with **pyrimisulfan** and **penoxsulam**, that can be used for controlling dollarweed, sedges, kyllinga, and many broadleaf weeds.

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 for controlling annual bluegrass and many broadleaf weeds including spurge. Xonerate may also be applied in combinations or sequential programs with other herbicides for controlling tropical signalgrass (*Urochloa subquadripara*). Basagran (**bentazon**) is an inhibitor of photosynthesis in susceptible species. 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 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. **MCPP** is most effective in the control of several perennial and winter annual weeds such as clovers (*Trifolium* spp.).

Clopyralid is a non-phenoxy herbicide sold as Lontrel for nonresidential turf. It provides broad-spectrum control of broadleaf weeds including lespedeza, clovers, and yellow woodsorrel (*Oxalis stricta*). **Quinclorac** (Drive, others) controls numerous broadleaf weeds, including clovers, but the primary use of quinclorac in seashore paspalum is postemergence control of crabgrass and torpedograss. Quinclorac is also found in mixture products including Q4-Plus and Solitare.

***Carotenoid biosynthesis inhibitors*.** **Topramezone** (Pylex) is a postemergence herbicide for crabgrass and goosegrass control. It controls susceptible weeds through the inhibition of carotenoid biosynthesis. Susceptible weeds exhibit bleaching symptoms (whitening) from this mode of action that will persist for 10 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 late summer or 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.

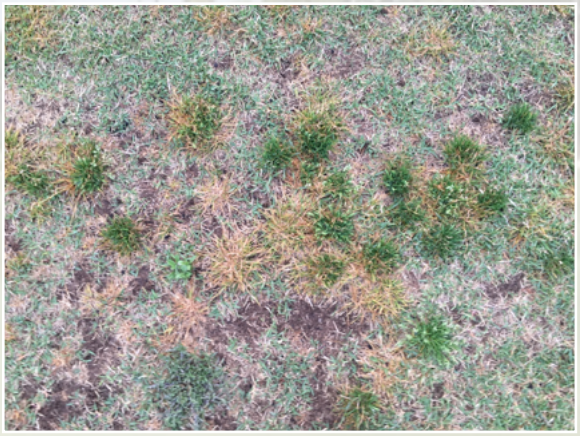
Kerb (**pronamide**) is a Group 3 with a different site of action than the dinitroanilines. It provides pre- and early postemergence control of annual bluegrass. Paspalum managers will optimize the efficacy of Kerb in early winter to control immature annual bluegrass and extend residual control during peak germination. Kerb is highly mobile and should be used with caution against cool-season grasses or other species susceptible to injury. Spring applications of Kerb can control mature annual bluegrass, but the speed of control is slow, compared with other herbicides, and may be unacceptable for most end-users.

Tower (**dimethenamid**) and StriCore (**pethoxamid**) can provide another mode of action for preventative control of annual bluegrass in paspalum. Sequential applications of reduced rates, such as 21 oz/acre, should be used when Tower is applied for annual bluegrass control or in combinations with Group 3 herbicides to mitigate paspalum injury. Higher rates of Tower in fall and winter can stunt paspalum growth and reduce turf quality during periods when recovery potential is limited. Winter applications of StriCore in fall on 'Platinum' paspalum have shown good safety at labeled use rates of 24 to 48 oz/acre when applied alone or in sequential programs with prodiamine. These chemistries can be used in rotation with Group 3 herbicides, Specticle, and other herbicides.

Specticle Flo (**indaziflam**) can provide excellent control of annual bluegrass when applications are made prior to germination in fall (Table 1). A major concern with Specticle use is turfgrass injury due to leaching in sandy soils with low organic matter, commonly found in regions where paspalum is grown. Application rates and regimens need to be modified in sandy soils by making sequential applications of Specticle Flo at 2 to 3 oz/acre. Generally, 1 oz/acre of Specticle Flo will provide about four weeks of residual control of annual bluegrass and other weeds. However, frequent use of any herbicide at low rates will lead to the eventual development of resistance and these programs are not sustainable. Therefore, rotation with other herbicides, such as Kerb, Tower, or Ronstar may be needed for long-term success.

Ronstar 2G (**oxadiazon**) offers an alternative mode of action to the DNAs for preemergence control of annual bluegrass in seashore paspalum (Table 1). Oxadiazon and bensulide are found in the combination product Anderson's Goose and Crab. These herbicides often provide erratic levels of annual bluegrass control, but provide an alternative mode of action for rotation programs with other preemergence herbicides. Recent restrictions from the EPA regarding Ronstar use on golf courses may also limit the acreage and amount permitted for use to control annual bluegrass. **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 limited residual control during periods of peak germination.

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), **sulfosulfuron** (Certainty), and **imazaquin** (Image) are the only ALS-inhibitors labeled for seashore paspalum with efficacy for annual bluegrass control. Katana can be applied at 1.5 oz/acre in late November or December to seedling annual bluegrass. Rates and timing of applications are critical for the selectivity of sulfonylurea herbicides in paspalum. This recommended application timing is when annual bluegrass is most susceptible to control, and the residual effects of Katana can prevent the establishment of new seedlings during peak periods of germination. Certainty and Image are 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 of seashore paspalum, especially when paspalum is in root regeneration and recovering from stress. Severe injury or delays in greenup may occur at rates required to control annual bluegrass at these scheduled applications.



Segregation of annual bluegrass biotypes after a sulfonylurea application.

Annual bluegrass resistance to ALS-inhibitors has become widespread throughout the southern United States and alternative modes of action in tank-mixtures or sequential applications may be needed for postemergence control. 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 spring. Turf managers may apply Xonerate 2SC from 6 to 12 fl oz/acre in seashore paspalum for annual bluegrass control. Sequential treatments at a two to three-week interval may be required for controlling annual bluegrass in spring. See labels for application instructions for seashore paspalum. PoaCure (**methiozolin**) is labeled for use in seashore paspalum golf courses, including putting greens. It offers an alternative mode of action to other herbicides used for annual bluegrass control in paspalum. Turf managers should time initial applications after early emergence of annual bluegrass. Sequential applications on a 14-day interval at 0.6 to 1.2 oz/1000 sq ft are necessary for acceptable control in winter. PoaCure will require irrigation after application to optimize root uptake.

Crabgrass and Goosegrass. Turf managers may use dinitroaniline (Group 3 herbicides) 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 in regions where paspalum is grown. Ronstar effectively controls crabgrass and goosegrass, but must be applied in a granular formulation during active growth due to excessive injury potential from sprayable applications. Specticle Flo (**indaziflam**) effectively controls goosegrass in preventative programs. However, reduced application rates that are necessary to use Specticle in sandy soils will require repeat applications on about six to eight-week intervals to extend residual control. Tower (**dimethenamid**) and StriCore (**pethoxamid**) can control goosegrass in paspalum, but these herbicides have short-lived soil residual that will require sequential treatments after about four to six-weeks depending on application rate. These limitations, along with herbicide costs, may present challenges to controlling these annual grassy weeds.

Smooth crabgrass (*Digitaria ischaemum*)

Goosegrass (*Eleusine indica*)

Quinclorac (Drive, others) is the active ingredient in Drive and numerous combination products (ex. Q4 Plus, 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 may 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. Dimension will also control perennial crabgrasses, such as India crabgrass, that may be problematic in regions where paspalum is grown. To optimize efficacy, Dimension needs to be applied with a non-ionic surfactant for postemergence control of these crabgrasses during periods of active growth.

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. Spot treatments of sulfentrazone can also cause severe burn to paspalum, especially in summer at high rates, and applicators should be cautious if temporary injury is unacceptable.

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), **sulfosulfuron** (Certainty), and **pyrimisulfan** (Arkon). 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 6) 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**) 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. There are currently six sedge species with reported ALS-resistance including annual sedge (*Cyperus compressus*) from turfgrass. Recently, green kyllinga (*Kyllinga brevifolia*) with resistance to ALS-inhibitors has been confirmed in Florida. 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 the 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 8 fl oz/acre + Sedgehammer or Certainty at 1.25 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 DNA herbicide (Freehand) 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 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** (Prograss), which may be used in combination with **flurprimidol** (Cutless) to control bermudagrass (Table 2). Applications at labeled rates should begin after bermudagrass has resumed active growth in spring. Sequential applications at a three-week interval with Prograss will be needed to suppress bermudagrass in seashore paspalum in summer. The differential tolerance levels between species will enable seashore paspalum to become more competitive with bermudagrass over time and reduce infestations.

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 approximately 70° 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 herbicides for postemergence spurge control. This treatment has traditionally been 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 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 a sulfonylurea 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.

Tower (**dimethenamid**) provides short-term preemergence control of spurge at labeled application rates (21 to 32 fl oz/acre). Sod growers utilize Tower for spurge control because it causes minimal restrictions on lateral rooting of seashore paspalum. Freehand (**dimethenamid + pendimethalin**) can also be used 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**), Specticle (**indaziflam**) or granular Ronstar (**oxadiazon**). However, populations that overwinter in a vegetative state are not controlled by preemergence herbicides and thus, postemergence options are needed.

Group 3 herbicides, such as Dimension, or Specticle Flo can be applied in late spring as tropical signalgrass transitions to active growth. These herbicides can effectively inhibit lateral roots of tropical signalgrass to reduce the spread and growth of perennial infestations. Mechanical raking and physical removal will also be much easier on tropical signalgrass patches with lateral runners that are not tacking down healthy roots in soil. Sequential programs with postemergence herbicides will also enhance tropical signalgrass control in paspalum.

Seashore paspalum is susceptible to injury from most postemergence herbicides that selectively control tropical signalgrass in bermudagrass. Xonerate (**amicarbazone**) alone or in sequential programs with Dismiss (**sulfentrazone**) can be used in late spring when paspalum is actively growing. The initial treatments should be made after tropical signalgrass has resumed active growth in the spring with sequential applications on a two to three-week schedule. Xonerate can be tank-mixed with Pylex or low rates of Roundup for spot treatment programs to enhance efficacy for tropical signalgrass control. Other options include hand-weeding or spot treatments of glyphosate followed by salt applications to enhance desiccation of the tropical signalgrass in seashore paspalum. Applying salt at 10 to 20 lb/1000 sq ft with dew can effectively control tropical signalgrass after herbicide applications or if regrowth is detected in fall.

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: Manuscript (pinoxaden), StayGuard (flumioxazin), MSMA, triclopyr, diclofop, fenoxaprop, fluazifop, sethoxydim, atrazine, simazine, metribuzin, foramsulfuron (Revolver), trifloxysulfuron (Monument), Tribute Total, and Celsius.

Table 1. Preemergence herbicides labeled 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. Apply only to established turf.
	pendimethalin	Pendulum AquaCap, others	1.5 to 2.5 lb ai	Apply for preemergence control of grassy weeds and selected broadleaf weeds in residential and non-residential turfgrass.
	prodiamine	Barricade, others	0.5 to 0.75 lb ai	Provides preemergence control of grassy weeds and selected broadleaf weeds. Do not apply to golf greens or stressed turf.
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	1.5 to 3 lb ai	Controls annual grassy weeds, annual sedges, and some broadleaf weeds. Only apply the granular formulations to seashore paspalum. Do not apply to wet turf. May cause temporary turf discoloration.
	sulfentrazone	Dismiss 4SC	8 to 12 fl oz	Provides preemergence control of annual sedges, kyllinga, broadleaf weeds, and goosegrass. Injury could result from applications on turfgrass that is not well established or weakened by stress.
15	dimethenamid	Tower	21 to 32 fl oz	Provides preemergence control of annual sedges, doveweed, goosegrass, and annual broadleaf weeds including spurge. Do not apply more than 64 fl oz/acre per year. Make sequential applications at 5 to 8 week intervals.
15	pethoxamid	StiCore	24 to 48 fl oz	Provides preemergence control of annual sedges, doveweed, goosegrass, and annual broadleaf weeds. Do not apply more than 48 fl oz/acre per year. Make sequential applications at 4 to 6 week intervals.
15 + 3	dimethenamid + pendimethalin	FreeHand	100 to 200 lb	Controls some grassy weeds, annual sedges, doveweed, and annual broadleaf weeds. Do not exceed 400 lb/acre per year. Delay applications for two months after sprigging and roots are established.

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 alone or with Cutless (flurprimidol).
29	indaziflam	Specticle Flo	3 to 6 fl oz	Provides preemergence control of goosegrass, annual bluegrass, tropical signalgrass, and various broadleaf weeds. Do not exceed 3 oz/acre per application on paspalum grown in sandy soils with low organic matter. Do not apply upslope to golf greens and sensitive grasses. See label for further information on use in paspalum.

[a]WSSA 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 labeled for use in seashore paspalum.

WSSA Group[a]	Common Name	Trade Names	Application Rates (per acre)	Comments
2	flazasulfuron	Katana 25WG	1.5 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. Flazasulfuron will also control annual and perennial sedges and kyllinga. Apply with a surfactant at 0.25% vol/vol.
	halosulfuron	Sedgehammer, Prosedge, 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.
	pyrimisulfan	Arkon	3.4 to 4.7 pt	Controls broadleaf weeds, annual and perennial sedges, and kyllinga. Adjuvants are not required with Arkon but may be used to optimize efficacy.
2	pyrimisulfan + penoxsulam	Aethon	3.4 to 4.7 pt	Controls broadleaf weeds, annual and perennial sedges, and kyllinga.
	sulfosulfuron	Certainty 75WG	1.25 oz	Controls 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.
4	2,4-D + dicamba + MCPP	Trimec Southern, others	See label	Controls annual and perennial broadleaf weeds. Do not apply to paspalum under stress from heat, disease, or pests. See labels for use in seashore paspalum.
	clopyralid	Lontrel	0.25 to 1.3 pt	Controls annual and perennial broadleaf weeds in non-residential turf. Do not collect grass clippings for mulch or compost from treated areas.
	dicamba	Vanquish 4L, others	0.5 to 1 pt	Controls annual and perennial broadleaf weeds including spurge and lespedeza. Do not exceed 2 pt/acre per year.
	quinclorac	Drive, others	0.75 lb ai	Controls crabgrass, barnyardgrass, and broadleaf weeds. Make applications with a crop oil or methylated seed oil at 0.5 to 1% v/v. May cause slight discoloration.
4 + 14	2,4-D + dicamba + MCPA + carfentrazone	Speedzone Southern	2 to 4 pt	Controls broadleaf weeds and suppresses goosegrass. 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 8 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.
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. May increase speed of control when used with other herbicides.

	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.
	sulfentrazone + carfentrazone	Dismiss NXT	10 to 15 fl oz	
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 pests.
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.
Not classified	methiozolin	PoaCure	26 to 48 fl oz	Provides pre- and early postemergence control of annual bluegrass. Application programs in paspalum should include three biweekly treatments at 26 oz/acre at the early-postemergence timing. See label for recommended application rates and regimens.

[a]WSSA 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. 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 + MCPA + 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	No	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	No	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
methiozolin	T	Yes	PoaCure
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
pethoxamid	T	Yes	StriCore
prodiamine	T	Yes	Barricade, others
prodiamine + sulfentrazone	T	Yes	Echelon
pronamide	T	Yes	Kerb
pyrimisulfan	T	Yes	Arkon, Vexis
pyrimisulfan + penoxsulam	T	Yes	Aethon
quinclorac	T	Yes	Drive, Drive XLR8, others
siduron	T	No	Tupersan
sulfentrazone	T	Yes	Dismiss
sulfentrazone + imazethapyr	T	No	Dismiss South
sulfentrazone + carfentrazone	T	Yes	Dismiss NXT
sulfentrazone + metsulfuron	T	No	Blindside
sulfentrazone + quinclorac	T	Yes	Solitare
sulfosulfuron	T	Yes	Certainty
topramezone	I	Yes	Pylex