

**Final Report**  
**Undesirable Roadside Vegetation**  
**FDOT Contract Number: BDK75 977-54**  
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**Submitted to:**  
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## **DISCLAIMER**

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation.

## METRIC CONVERSION TABLE

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>LENGTH</b>				
<b>in</b>	inches	25.4	millimeters	mm
<b>ft</b>	feet	0.305	meters	m
<b>yd</b>	yards	0.914	meters	m
<b>mi</b>	miles	1.61	kilometers	km

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>AREA</b>				
<b>in<sup>2</sup></b>	square inches	645.2	square millimeters	mm <sup>2</sup>
<b>ft<sup>2</sup></b>	square feet	0.093	square meters	m <sup>2</sup>
<b>yd<sup>2</sup></b>	square yard	0.836	square meters	m <sup>2</sup>
<b>ac</b>	acres	0.405	hectares	ha
<b>mi<sup>2</sup></b>	square miles	2.59	square kilometers	km <sup>2</sup>

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>VOLUME</b>				
<b>fl oz</b>	fluid ounces	29.57	milliliters	mL
<b>gal</b>	gallons	3.785	liters	L
<b>ft<sup>3</sup></b>	cubic feet	0.028	cubic meters	m <sup>3</sup>
<b>yd<sup>3</sup></b>	cubic yards	0.765	cubic meters	m <sup>3</sup>
NOTE: volumes greater than 1000 L shall be shown in m <sup>3</sup>				

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>MASS</b>				
<b>oz</b>	ounces	28.35	grams	g
<b>lb</b>	pounds	0.454	kilograms	kg
<b>T</b>	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
<b>TEMPERATURE (exact degrees)</b>				
<b>°F</b>	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C

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16. Abstract Research was conducted to determine if the current list of undesired vegetation in the current Maintenance Rating Program handbook adequately listed species present in areas where turf scores were consistently low, if the different climate zones of Florida warranted an undesired species list by district, and if soil pH could be one of the causative factors in bahiagrass decline in rights-of-way. Results of this research indicated that maidencane, tropical soda apple, and dogfennel could be removed from the current list, while species such as giant smutgrass, matchweed, teaweeds, white head broom, and largeflower pusley could be added to the list. Since most of the species that appear to be problematic are present statewide, there is likely no reason to produce district-specific undesired vegetation lists. Soil pH was at least 7.6 at all research sites, indicating that bahiagrass growth would be reduced significantly.			
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## EXECUTIVE SUMMARY

The current Maintenance Rating Program (MRP) handbook contains a list of fourteen plant species that are undesirable and should not be present in greater than 25% of a given area. This list of species has not been evaluated for a number of years and may not adequately describe the species that are most commonly problematic where turf scores have been consistently low. The hypotheses for this research are that the current list of undesired vegetation does not adequately cover the most problematic species in areas where turf conditions do not meet MRP standards, that undesired vegetation in South Florida is different from that in North Florida, and that soil pH may be the causative factor where weed invasion is extreme. Cogongrass (*Imperata cylindrica*), maidencane (*Panicum hemitomon*), and tropical soda apple (*Solanum viarum*) were not observed in any of the test areas. Tropical soda apple, another federal and state noxious weed, could be removed from the list as the number of mowing cycles on rights-of-way likely precludes it from becoming problematic. Dogfennel was only observed as problematic in one location, and since it does not tolerate repeated mowing, we believe that it can also be removed from the current MRP list of undesired vegetation. Other species that should be added to the list that were present in over 50% of the districts include giant smutgrass, matchweed, teaweeds and white head broom. Matchweed is a mat-forming perennial and can quickly take over weak turfgrass stands. White head broom appears to be increasing in south Florida as it is tolerant of repeated clipping. Other species that may be included include bull paspalum (*Paspalum boscianum*) as it was present in three of the eight districts. Largeflower pusley (*Richardia grandiflora*) was present in District IV and the Turnpike; however, personnel in those districts indicated that it is becoming an increasing problem. The current MRP list, minus the three that should be removed, contains species that are fairly common throughout all districts. In addition to the eleven species remaining on the MRP list, teaweeds, giant smutgrass, and matchweed were found in at least five of the districts. In contrast, bull paspalum was only observed in Districts II, V, and VII, whereas largeflower pusley and white head broom were observed only in the south districts. As species tend to move throughout the state by various dispersal mechanisms, it is most likely not necessary to delineate between north and south Florida with regards to the list of undesired vegetation. The pH of all soil samples ranged from 7.6 to 7.9 and may be the cause of bahiagrass decline in rights-of-way.

The results of this research indicate that maidencane, castor bean, dogfennel, and tropical soda apple are not needed on the undesired list of vegetation in the MRP handbook. However, giant smutgrass, matchweed, teaweeds (southern and arrow leaf sida), white head broom and largeflower pusley should be considered as additional species on the MRP undesirable vegetation list. Considering that most of the species are present statewide, there is not a need to produce a list of district-specific species. However, a list of “weeds to watch” could be presented to each district and evaluated at a later date for inclusion in the MRP handbook. Amending soil pH by the addition of elemental sulfur could help in the sustainability of bahiagrass stands on rights-of-way; however, it may not be economically feasible. Therefore, other turfgrasses should be evaluated for sustainability on rights-of-way.

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## INTRODUCTION

Currently roadside vegetation is rated using the list of 14 undesirable species (Table 1) in the vegetation and aesthetic section of the Maintenance Rating Program (MRP) handbook. This section has not been updated in over 10 years. Furthermore, a statewide listing of undesirable species may not be appropriate as species invasion into the rights-of-way is dependent upon climate zones, time of year, and the varying soil conditions throughout the state. Identifying the species of undesirable vegetation by climate zones (Districts) and updating the MRP handbook would aid in providing the MRP an updated tool to better evaluate true turf conditions within our rights-of-way statewide.

Table 1. Current list of undesired vegetation in mowed areas of rights-of-way. Source: Florida Department of Transportation Maintenance Rating Program Handbook, page 125.

<b>Common name</b>	<b>Scientific name<sup>1</sup></b>
<b>cogongrass</b>	<i>Imperata cylindrica</i>
<b>vaseygrass</b>	<i>Paspalum urvillei</i>
<b>johnsongrass</b>	<i>Sorghum halepense</i>
<b>broomsedge</b>	<i>Andropogon</i> spp. <sup>2</sup>
<b>dogfennel</b>	<i>Eupatorium capillifolium</i>
<b>ragweed</b>	<i>Ambrosia artemisiifolia</i>
<b>castor bean</b>	<i>Ricinus communis</i>
<b>maidencane</b>	<i>Panicum hemitomon</i>
<b>rhodesgrass</b>	<i>Chloris</i> spp. [ <i>Eustachys</i> spp.]
<b>goosegrass</b>	<i>Eleusine indica</i>
<b>sandspur</b>	<i>Cenchrus</i> spp.
<b>Spanish needles</b>	<i>Bidens alba</i>
<b>crowsfoot grass</b>	<i>Dactyloctenium aegyptium</i>
<b>tropical soda apple</b>	<i>Solanum viarum</i>

<sup>1</sup>Scientific names are those provided by the Weed Science Society of America ‘Composite List of Weeds’.

<sup>2</sup>Plants with more than one similar species are denoted by ‘spp.’ to indicate that more than one species in this genus is known and is commonly found on rights-of-way.

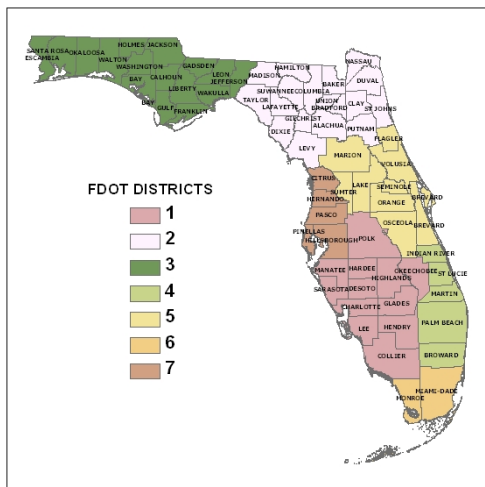
Florida’s climate ranges from humid subtropical in north and central Florida to tropical in south Florida. A humid subtropical climate is characterized by hot, humid summers and generally mild to cool winters. The southernmost part of the state is generally described as a tropical savanna region; tropical savanna precipitation is highly concentrated in the warmer months (Fraisie et al. 2011). Florida’s climate is divided into 7 climate divisions (Figure 1), with average low temperatures during January (coldest month) ranging from the lower 50’s in the north (climate divisions 1 and 2) to the high 60’s in the south (climate divisions 6 and 7). The number of days with minimum temperatures equal to or below 32°F is as high as 34 in climate division 1 to 0 days in climate divisions 6 and 7 (SERCC 2012). Average temperatures in the hottest months (July and, in some areas, August) are similar throughout the state, ranging between 81 and 84°F.

The Florida Department of Transportation is divided into seven districts in addition to the Turnpike Authority (Figure 2). The current list of undesired vegetation in Table 1 is a statewide list of species that are undesired on highway rights-of-way. With Florida's range of climate characteristics, speciation varies throughout the state. North Florida is dominated by subtropical and temperate species, whereas south Florida is dominated by tropical and subtropical species. Therefore, a change in problematic species is likely to be observed in North Florida districts compared to South Florida. The hypotheses for this research are that the current list of undesired vegetation does not adequately cover the most problematic species in areas where turf conditions do not meet MRP standards, that undesired vegetation in South Florida is different from that in North Florida, and that soil pH may be the causative factor where weed invasion is extreme.

Figure 1. Florida's climate divisions. Available at <http://edis.ifas.ufl.edu/ae267>.



Figure 2. The Florida Department of Transportation is decentralized into seven districts (plus the Turnpike Enterprise) in accordance with legislative mandates.





## LITERATURE REVIEW

Roadside perennial grasses maintain the integrity of highway rights-of-way and roadbeds by aiding in soil stabilization and reduced soil erosion. These rights-of-way also provide a safety zone for motorists during breakdowns and during extreme weather events. Due to the importance of these rights-of-way in maintaining roadway integrity and motorist safety, rights-of-way should be managed for sustainability and quality.

Roadside turfgrasses include centipedegrass (north Florida), St. Augustine, bermudagrass, and predominantly bahiagrass. Bahiagrass is the most widely utilized species for roadside stabilization due to its tolerance to low levels of soil fertility, drought tolerance, limited flooding tolerance, and pest (nematode) resistance (Newman et al. 2011; Trenholm et al. 2011). Bahiagrass is also adapted to acidic soil conditions, a condition common in native soils of Florida. Bahiagrass growth is optimum at soil pH of 5.5 to 6.0 as this is the level of soil pH where nutrient uptake is adequate (Mackowiak et al. 2008). If the soil is too acidic (soil pH <5.0), boron, sulfur, and molybdenum deficiencies may occur and manganese may become toxic. In contrast, if soil is too alkaline (soil pH > 6.5), several micronutrient (iron, copper, zinc, and cobalt) deficiencies may occur (Silveira et al. 2012). Therefore, ensuring that soil pH is at the appropriate level will increase the persistence of a bahiagrass stand.

Highways are highly engineered systems with rights-of-ways functioning to maintain the integrity of the highway by reducing the amount of soil erosion and allowing rapid water drainage from the road surface. Modified soils are used to aid in roadside stability. The characteristics of these soils are largely unknown to the general public, but are commonly a mixture of clay and sand, or a mixture of subsoil with topsoil. Furthermore, substrates used in road construction have been suggested to modify soil properties such as pH, particle size, texture, nutrient levels, and water hold capacity (Fox and Fox 1986). This modified soil, therefore, may be detrimental to turfgrass persistence on rights-of-way.

## METHODOLOGY

*Determine the undesirable vegetation present in each District.* Two to four field research sites were established in each district (Table 2) to inventory the vegetation species present along right-of-way. Meetings were established with each district director and/or MRP team leader or designee within each district at locations where MRP scores have been consistently low for turf quality. At each location, the species present including desirable turfgrass were recorded. If specific areas had been subject to excessive soil erosion, this was also noted. Each research site was visited at least two times to determine species seasonality. The list of species was compared with current MRP list of undesired vegetation, and recommendations for an amended undesired vegetation list were developed.

*Soil sampling.* To determine if soil pH may be a causative factor for turfgrass decline in areas with consistently low MRP scores, soil samples were collected from one site in each district. Soil samples were collected by removing one-inch soil cores to a six-inch depth. Twenty soil

cores were removed from each location, bulked, mixed, and air-dried until analysis. Soil pH was determined using a 1:2 soil:water slurry (1:2 v/v) and measured with a pH meter.

Table 2. Locations of research plots where turf scores did not meet MRP standards.

District	Locations
<b>I</b>	1) SR 17, Median north of North Crossover Road, Bartow 2) SR 17; Median north of Old Bowling Green Road, Ft. Meade
<b>II</b>	1) HWY 24 at Levy County/Alachua County Line 2) Levy County 2.2 miles from location 1 3) HWY 441 north of McIntosh
<b>III</b>	
<b>IV</b>	1) Cypress Creek Road Exit Ramp I-95 MP 16.372 2) I-75 mp 13.765 3) US 27N mp 16.388 4) SR823/Flamingo Road
<b>V</b>	1) HWY 19 2) HWY 50 3) SR471
<b>VI</b>	1) 138 <sup>th</sup> St. next to 826 expressway 2) Krome Road (just off of US 27 N)
<b>VII</b>	1) Intersection of HWY 98 and 19 2) HWY 98
<b>Turnpike</b>	1) SR821 mp 9 2) SR821 mp 6 (Tallahassee Road) 3) Seminole expressway mp 39 4) Lake Mary exit, Seminole expressway

## FINDINGS

Plant species during the summer growing season were quite variable where turf condition does not meet MRP standards throughout the state (Table 3). Common ragweed (*Ambrosia artemisiifolia*), crowfoot grass (*Dactyloctenium aegyptium*), giant smutgrass (*Sporobolus indicus* var. *pyramidalis*), matchweed (*Phyla nodiflora*), rock fingergrass (*Eustachys petraea*), sandbur (*Cenchrus* spp.), Spanish needles (*Bidens alba*), spurge species (*Euphorbia* spp.), teaweed species (*Sida* spp.; southern and arrowleaf sida), and white head broom (*Spermacoce verticillata*) were present in at least 50% of the districts where turf conditions did not meet MRP standards.

Table 3. Occurrence of weed species in rights-of-way with consistently low MRP scores.

Common name <sup>1</sup>	Scientific name	Districts								Total
		I	II	III	IV	V	VI	VII	Turnpike	
bristly starbur	<i>Acanthospermum hispidum</i>									
broomsedge spp.	<i>Andropogon</i> spp.							Y		1
bull paspalum	<i>Paspalum boscianum</i>		Y			Y		Y		3
castor bean	<i>Ricinus communis</i>						Y			1
chamber bitter	<i>Phyllanthus urinaria</i>				Y					1
common ragweed	<i>Ambrosia artemisiifolia</i>		Y	Y	Y	Y	Y	Y		6
crabgrass spp.	<i>Digitaria</i> spp.						Y			1
creeping indigo	<i>Indigofera campestris</i>	Y								1
crowsfoot grass	<i>Dactyloctenium aegyptium</i>	Y	Y		Y	Y	Y	Y	Y	7
dayflower spp.	<i>Commelina</i> spp.	Y								1
dewberry	<i>Rubus trivialis</i>							Y		1
dogfennel	<i>Eupatorium capillifolium</i>							Y		2
Florida betony	<i>Stachys floridana</i>		Y					Y		2
Florida pusley	<i>Richardia scabra</i>			Y		Y				2
giant smutgrass	<i>Sporobolus indicus</i> var. <i>pyramidalis</i>	Y		Y	Y	Y	Y	Y	Y	7
goldenrod spp.	<i>Solidago</i> spp.					Y				1
goosegrass	<i>Eleusine indica</i>						Y			1
largeflower pusley	<i>Richardia grandiflora</i>				Y				Y	2
matchweed	<i>Phyla nodiflora</i>		Y	Y	Y	Y		Y	Y	6
Mexican tea	<i>Chenopodium ambrosioides</i>					Y		Y		2
morningglory spp.	<i>Ipomoea</i> spp.				Y		Y			2
peppervine	<i>Ampelopsis arborea</i>							Y		1
periwinkle	<i>Vinca minor</i>						Y			1
primrose spp.	<i>Ludwigia</i> spp.							Y		1
puncturevine	<i>Tribulus terrestris</i>				Y					1
red spiderling	<i>Boerhavia diffusa</i>					Y		Y		2
rock fingergrass	<i>Eustachys petraea</i>					Y	Y	Y	Y	4
sandbur	<i>Cenchrus</i> spp.		Y	Y	Y	Y		Y		4
sedge spp.	<i>Cyperus</i> spp.			Y		Y		Y		3
sicklepod	<i>Cassia obtusifolia</i>					Y		Y		2
sorghum spp.	<i>Sorghum</i> spp.				Y					1
Spanish needles	<i>Bidens alba</i>	Y	Y	Y	Y	Y	Y	Y	Y	7
spiny pigweed	<i>Amaranthus spinosus</i>				Y					1
spurge spp.	<i>Euphorbia</i> spp.	Y	Y			Y	Y			4
teaweed spp.	<i>Sida</i> spp.	Y		Y	Y	Y	Y	Y	Y	6
vaseygrass	<i>Paspalum urvillei</i>			Y				Y		2
whitehead broom	<i>Spermacoce verticillata</i>	Y			Y		Y		Y	4
yellow foxtail	<i>Setaria glauca</i>								Y	1

<sup>1</sup>When plants of the same genus were recognized with more than one species present, they were lumped into the genus grouping.

Plant species during the winter growing season were relatively consistent throughout the state (data not shown). Species that were present in areas where turf conditions did not meet MRP standards included Carolina geranium (*Geranium carolinianum*), cudweed species (*Gnaphalium* spp.), Virginia pepperweed (*Lepidium virginicum*), red sorrel (*Rumex acetosella*). Henbit

(*Lamium amplexicaule*), bur clover (*Medicago polymorpha*), common chickweed (*Stellaria media*), common catsear (*Hypochoeris radicata*), and prickly lettuce (*Lactuca serriola*) were observed only in District III. Spanish needles tended to overwinter in south Florida where frost events were not common. Matchweed was present in sites in south Florida where frost did not occur and regrowth was evident in north Florida sites by the beginning of March. In sites where crowfoot grass was prevalent during the summer growing season, the sites remained 85-90% bare ground (no green vegetation) until the following June when crowfoot grass began to emerge.

Soil samples were collected from each district to determine the pH of the soil. In all districts where undesired vegetation exceeded 25% of the area, soil pH ranged from 7.6 to 7.9 (data not shown).

## DISCUSSION

The first hypothesis of this research was that the current list of undesirable vegetation in rights-of-way does not adequately reflect the most problematic species in areas where turf condition does not meet MRP standards. The current MRP list of weeds (Table 1) lists fourteen species. Our observations of areas where MRP scores were consistently low include a total of 37 species (Table 3). However, only a subset of these was consistent throughout all districts. Plant species including cogongrass (*Imperata cylindrica*), maidencane (*Panicum hemitomon*), and tropical soda apple (*Solanum viarum*) were not observed in any of the test areas. This implies that these three species should be removed from the current MRP list of undesired vegetation. However, we caution the removal of cogongrass from the list as it is federal and state listed noxious weed that does not respond to mowing; i.e., mowing does not help control the species. Tropical soda apple, another federal and state noxious weed, could be removed from the list as the number of mowing cycles on rights-of-way likely precludes it from becoming problematic. Dogfennel was only observed as problematic in one location, and since it does not tolerate repeated mowing, we believe that it can also be removed from the current MRP list of undesired vegetation. Other species that could be added to the list that were present in over 50% of the districts include giant smutgrass, matchweed, teaweeds and white head broom. Giant smutgrass is problematic as it rapidly forms seed heads after clipping (B. Sellers, personal observations). Matchweed is a mat-forming perennial and can quickly take over weak turfgrass stands; however, it rarely exceeds mowing limits. White head broom appears to be increasing in south Florida as it is tolerant of repeated clipping. Other species that may be included include bull paspalum (*Paspalum boscianum*) as it was present in three of the eight districts. Largeflower pusley (*Richardia grandiflora*) was present in District IV and the Turnpike; however, personnel in those districts indicated that it is becoming an increasing problem. Although not included in our research areas in Districts I and VI, it was observed in several instances along rights-of-way (B. Sellers, personal observations).

The second hypothesis of this research was that undesired vegetation may be different in south Florida as compared to north Florida. The current MRP list, minus the three that should be removed, contains species that are fairly common throughout all districts. In addition to those eleven species, teaweeds, giant smutgrass, and matchweed were found in at least five of the districts. In contrast, bull paspalum was only observed in Districts II, V, and VII, whereas

largeflower pusley and white head broom was observed only in the south districts. As species tend to move throughout the state by various dispersal mechanisms, it is most likely not necessary to delineate between north and south Florida with regards to the list of undesired vegetation. Furthermore, we propose that the reason for weed invasion may be due to the ecological characteristics of the sites rather than climatic differences.

The last hypothesis of this research was that soil pH may be the reason behind bahiagrass decline in rights-of-way. The pH of all soil samples ranged from 7.6 to 7.9. This level of pH far exceeds the recommended pH values for optimum nutrient uptake and bahiagrass growth (Silveira et al. 2012). Although bahiagrass is adapted to grow at soil pH from 4.5 – 6.5, the recommended pH for optimum bahiagrass growth and nutrient uptake is 5.5 (Hanlon et al. 2009; Mackowiak et al. 2008; Silveira et al. 2012). Other research shows that both bahiagrass shoot and root biomass begins to decline as pH rises above 5.5 (Rana et al. 2013). Therefore, the window where bahiagrass remains competitive with other species appears to be fairly small.

## **CONCLUSIONS**

The results of this research indicate that maidencane, castor bean, dogfennel, and tropical soda apple are not needed on the undesired list of vegetation in the MRP handbook. However, giant smutgrass, teaweeds (southern and arrow leaf sida), white head broom, and largeflower pusley could be considered as additional species on the MRP undesirable vegetation list. Considering that most of the species are present statewide, there is not a need to produce a list of district-specific species. However, a list of “weeds to watch” could be presented to each district and evaluated at a later date for inclusion in the MRP handbook.

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