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Managing Against the Development of Herbicide-Resistant Weeds: Sugarcane [1]

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Producing a profitable sugarcane crop in Florida partly depends on effectively controlling weeds that can reduce yields. Because they provide an efficient and cost-effective means of weed control, herbicides are a critical component of sugarcane weed management programs. However, in many cropping systems excessive use of a single herbicide or group of herbicides with the same site of action has resulted in the development of herbicide-resistant weeds (for more information refer to EDIS document SS-AGR-243, *Herbicide-Resistant Weeds*, http://edis.ifas.ufl.edu/ag239). When herbicide-resistant weed populations appear, standard weed control treatments often become ineffective. As a result, alternative means of control must be used. In crops, such as sugarcane, where a limited number of herbicides are registered, the loss of a single effective herbicide can be very costly. Thus, it is critical to manage herbicides in order to prevent or delay the development of herbicide-resistant weed populations.

In order to successfully manage herbicides against the development of herbicide-resistant weeds, you must have a basic understanding of which herbicides have the same site of action. Table 1 lists herbicides by group number, site of action, chemical family, common name, and trade name.

When planning an herbicide program to manage against herbicide resistance, it is ideal to avoid using a single herbicide or herbicide group in consecutive years. However, Group 4 (2,4-D), Group 5 (atrazine, ametryn, metribuzin, and other triazines), and Group 18 (asulam) herbicides are typically used in every year of a sugarcane crop because of the limited number of herbicides available and the perennial crop cycle of sugarcane.

Worldwide, over 60 weed species have developed resistance to the triazine herbicides. These biotypes include several members of the genera *Amaranthus, Chenopodium, Panicum,* and *Solanum,*

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which are commonly found in Florida sugarcane fields. Consequently, it is critical that other herbicide groups be utilized as part of an integrated weed control program to prevent the development of triazine-resistant weed populations. Although there are no reported cases of resistance to asulam, there is always a chance that resistant populations could develop. Until recently, asulam (Group 18) was the only herbicide that could be used for postemergence control of grass weeds in sugarcane. However, the registration of Envoke (Group 2) provides an alternate site of action for postemergence grass weed control. For most grassy weeds, tank mixtures of asulam and Envoke are an effective resistance management strategy. Herbicide resistance is more likely to be a problem in fields successively planted to sugarcane. Rotational crops and fallow periods provide a valuable opportunity to control weeds using tillage, flooding, or herbicides with different sites of action.

Although it is likely that small populations of herbicide-resistant weeds are already present in the Everglades Agricultural Area (EAA), herbicide resistance is currently not a significant problem. The continued use of integrated and properly managed weed control programs should ensure that resistance does not become a major issue in the future.

Table 1. Group number and site of action of herbicides commonly used in sugarcane and crops grown in rotation with sugarcane.

Group number and site of action	Chemical Family	Common Name	Trade Name(s)	Crop used in
Group 1 Acetyl CoA carboxylase (ACCase) inhibitors	aryloxyphenoxy-propionates	fenoxaprop	Acclaim	sod
		fluazifop	Fusilade DX	fallow, canal banks
		quizalofop	Assure II	vegetables
	cyclohexanediones	clethodim	Select, Selex Max	vegetables
		sethoxydim	Poast, Poast plus	vegetables
Group 2 Acetolactate synthase (ALS) inhibitors	sulfonylureas	bensulfuron-methyl	Londax	rice
		chlorsulfuron	Corsair	sod
		halosulfuron-methyl	Sempra, Sandea	sugarcane
		nicosulfuron	Accent	sweet corn
		trifloxysulfuron-sodium	Envoke	sugarcane
	pyrimidinylthiobenzoate	bispyribac-sodium	Regiment	rice
Group 3 Microtubule assembly inhibitors	dinitroanilines	oryzalin	Snapshot, Surflan	sod
		pendimethalin	Prowl 3.3, Prowl H2O, Pendimax	sugarcane
		prodiamine	Barricade	sod
Group 4 Synthetic auxins	phenoxy acetic acids	2,4-D	several	sugarcane, rice, sweet corn
	benzoic acid	dicamba	Banvel	sugarcane
Group 5 Photosystem II inhibitors	triazines	ametryn	Evik	sugarcane
		atrazine	Aatrex, Bicep II Magnum[2]	sugarcane, sweet corn
		hexazinone	K4[1]	sugarcane
		metribuzin	Sencor, Lexone	sugarcane
		simazine	Princep, Simazine	sweet corn
Group 6 Photosystem II inhibitors (same site as group 5, but different binding characteristics)	benzothiadiazinone	bentazon	Basagran	sweet corn, rice, vegetables
Group 7 Photosystem II inhibitors (same site as group 5 and 6, but different binding characteristics)	Ureas	diuron	Karmex, K4[1]	sugarcane
		linuron	Lorox	vegetables
	Amide	propanil	Stam M-4	rice
		napropamide	Devrinol	sod, basil
Group 8 Lipid synthesis inhibition (not ACCase inhibition)	Thiocarbamates	butylate	Sutan	sweet corn
		EPTC	Eradicane	sweet corn
		thiobencarb	Bolero	rice
	Phosphorodithioate	bensulide	Prefar	vegetables

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Group 9 EPSP synthase inhibitors	glycine	glyphosate	Roundup, Touchdown, others	fallow
Group 14 Protoporphyrinogen oxidase (PPO) inhibitors	triazolinone	carfentrazone	Aim	sugarcane, rice, sweet corn
	Diphenylethers	acifluorfen	Ultra Blazer	rice
		oxyfluorfen	Galligan, Goal	sweet corn
		fomesafen	Reflex	snap beans
	N-phenylphthalimides	flumioxazin	Valor SX	sugarcane
	Oxadiazole	oxadiazon	Ronstar	sod
Group 15 unknown site of action	Chloroacetamides	metolachlor	Dual Magnum, Pennant Magnum	sweet corn, sod
		pronamide	Kerb	sod
Group 16 unknown site of action	Benzofuran	ethofumesate	Prograss	sod
Group 18 DHP (dihydropteroate synthase step) inhibitors	Carbamate	asulam	Asulox, others	sugarcane
Group 21 Cell wall synthesis inhibitor (site B)	Benzamide	isoxaben	Gallery	sod
Group 22 Photosystem I electron diversion	Bipyridyliums	paraquat	Gramoxone Extra	fallow
Group 27 Hydroxyphenyl-pyruvate-dioxygenase inhibitors	Triketone	mesotrione	Callisto	sugarcane, sweet corn

[1] K4 is a commercial blend of diuron and hexazinone.

[2] Bicep II Magnum is a commercial blend of atrazine and metolachlor.