

# ▲▲▲ Weed Identification and Proper Herbicide Selection

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The correct identification and knowledge of its biology is important to enable appropriate preemergence and/or postemergence herbicide selection and ensure their efficacy. Understanding the seasonality and growth patterns of annual and perennial weeds in the desert will lead to optimum timing of applications for maximum levels of control.

Overuse of similar chemistries of herbicides may eventually result in weeds becoming resistant to families of herbicides. Users should be aware of the potential for resistance development and be watching out for weeds that were formerly easy to control and over time becoming more difficult to control with the same herbicide at the same rates.

Glyphosate is an effective and safe herbicide for controlling many weeds when used properly so reliable facts are presented to alleviate perceived fears. The brand name Roundup is becoming more prevalent and confusing in the marketplace so care must be given to reading product labels to know what is being sprayed.

## Identifying Problem Summer Weeds

- ▶ Spurges
- ▶ Purslane
- ▶ Fleabane
- ▶ Khakiweed
- ▶ Knotweed
- ▶ Crabgrass/Cupgrass
- ▶ Goosegrass
- ▶ Liverseedgrass
- ▶ Nutsedge

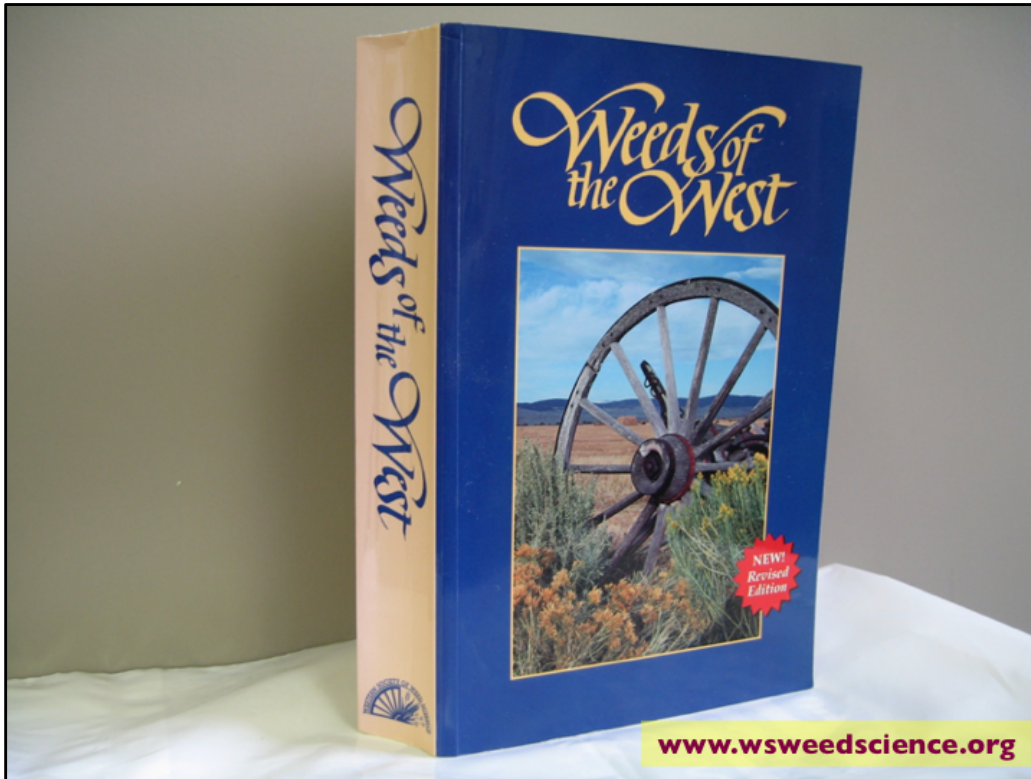
Some of the typical weeds that occur during the summer in turf and in landscapes are listed.

Liverseedgrass is possibly emerging as a newcomer in more sites around Phoenix.

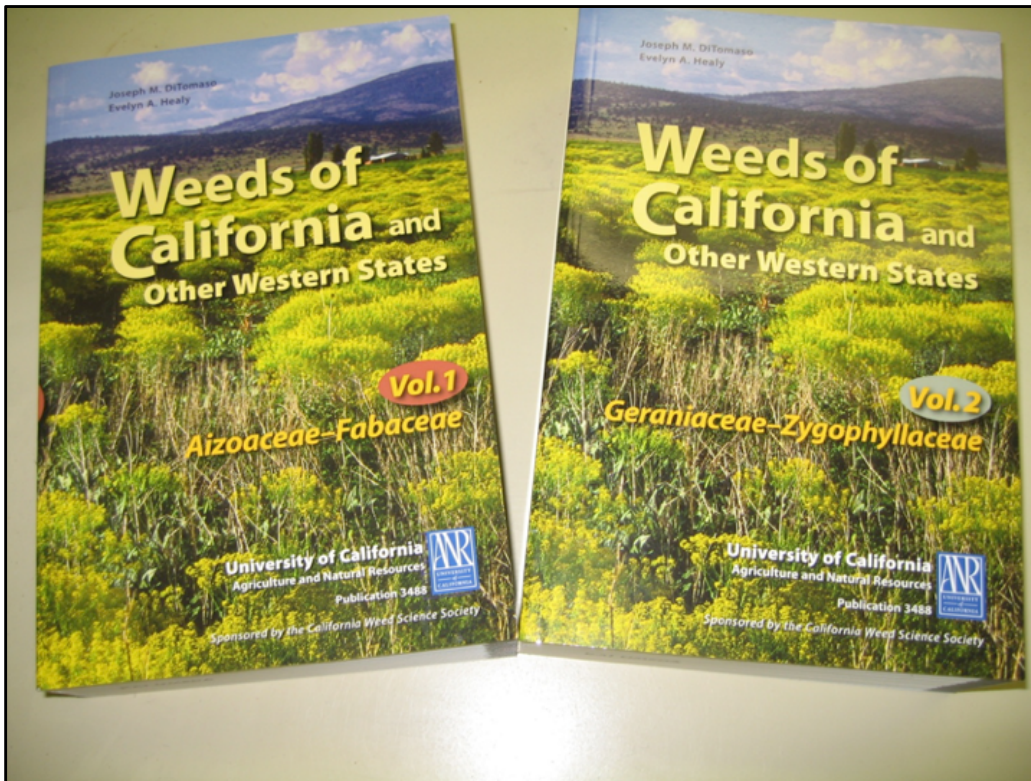
Purple nutsedge is more difficult to control and is more prevalent in AZ than is yellow nutsedge.

The presentation included images of these weeds.

They can be found in weed ID books.



Weeds of the West is out of print and very few are still available in bookstores.



This 2 volume weed ID reference resource should be on the bookshelf of every weed management practitioner's office.

## Herbicides must enter the plant

- ▶ Preemergence herbicides
  - ▶ Root absorbed
  - ▶ Some shoot absorption
- ▶ Postemergence herbicides
  - ▶ Foliar absorbed
  - ▶ Some root absorption

PRE herbicides are applied to the soil where the germinating seed has its roots and shoot exposed to the chemical

POST herbicides are sprayed onto the foliage of the weeds. The best efficacy is achieved when small and young susceptible weeds are treated before the plant matures and hardens off to better protect itself.

## Factors that influence herbicide absorption

- ▶ Herbicide characteristics
- ▶ Plant characteristics
- ▶ Environmental conditions
  - ▶ Soil properties
  - ▶ Weather
  - ▶ Irrigation

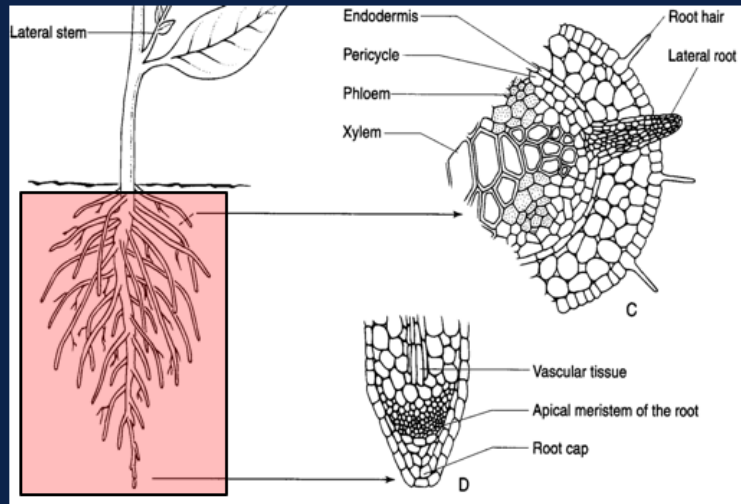
Herbicides are usually formulated products that can be mixed with water to be sprayed on the weed foliage or soil surface, or they can be spread as a dry granule or pellet to an area. Liquids that resemble a “milkshake” or a “syrup” generally mix with water in the spray tank very easily and are then ready to spray. Some powders or grains can be dissolved in water similarly and require constant shaking or agitation to be sprayed. Dry granules or pellets resemble fertilizer granules that must be broadcasted on bare ground or onto wet weed leaves.

Herbicides sprayed onto leaf surfaces penetrate more easily when there are few hairs or waxy cuticle layers are not yet developed. Woody stems of mature plants are more difficult for sprays to penetrate. Plants that are recently watered and not suffering from drought are more susceptible to herbicides. Weeds are more susceptible in the early morning or later evenings compared to high exposure to the mid-day sun and heat.

# Plant Characteristics

## ► Exposure to soil applied herbicide

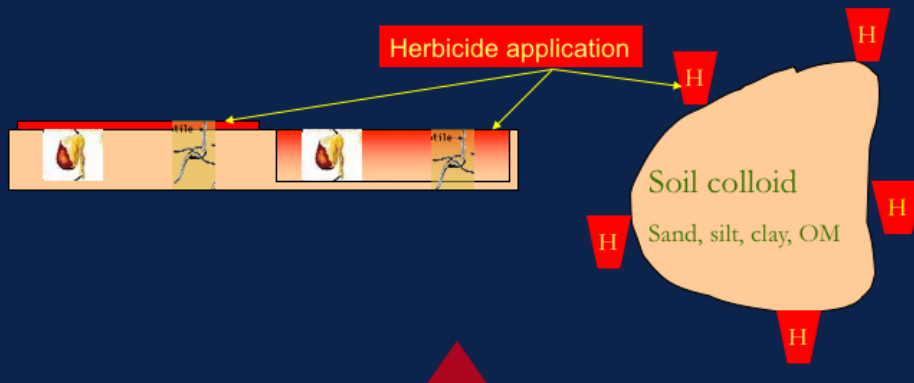
Roots are involved in  
- *water and nutrient uptake*,  
- *anchor* plants in soil, and  
- *store carbohydrates* and other nutrients



Soil-applied herbicides when incorporated into the soil expose the growing roots to the herbicide attached to the soil particles. Similar to taking up nutrients and water, the herbicide get taken up into the plants through the roots.

# Plant Susceptibility

- ▶ Preemergence herbicide application
  - ▶ Root uptake
    - ▶ Surface applied
    - ▶ Incorporated



PRE herbicides are applied to the soil surface and are then incorporated within the zone where weed seeds generally germinate at the top 2-3 inches of the surface. Mechanical mixing with a disk or harrow usually works well on well-tilled bare ground. In turf and landscapes, rainfall or overhead irrigation help the herbicide to be “activated” in the upper surface layers. Generally, the herbicide attaches to organic matter and/or clay components of the soil particles where they contact the roots.



## Controlling Problem Summer Weeds

- ▶ Preemergence herbicides
  - ▶ “Yellow” herbicides for overseeded and non-overseeded turfgrasses
    - ▶ Timing of application
  - ▶ Broadleaved weed selective herbicides
- ▶ Postemergence herbicides
  - ▶ Early stage timing!

This slide and the next 3 slides describe the timing of herbicide applications for turf. The “yellow” herbicides are the dinitroaniline (DNA) class of soil-applied PRE herbicides.

Prodiamine (Barricade), pendimethalin (Pendulum), and dithiopyr (Dimension, non-“yellow” but works in the same manner) should be applied about February-March to control crabgrass and cupgrass. It also controls small-seeded broadleaved weeds such as purslane and spurge. A follow-up application when the summer monsoon rains begin provide summer-long weed control.

POST herbicides are most effective when small and young weeds are sprayed. Flowering and seedhead forming weeds are mature and cannot be controlled economically with POST herbicides.

## Controlling Problem Winter Weeds

- ▶ Preemergence herbicides
  - ▶ “Yellow” herbicides for overseeded and non-overseeded turfgrasses
    - ▶ Pendulum, Barricade, Balan, Surflan
    - ▶ Dimension
  - ▶ Timing of application
    - ▶ August + December (overseed)
    - ▶ October + December (non-overseed)

The “yellow” DNA herbicide Barricade is also effective against *Poa annua*, annual bluegrass, when applied 6-8 weeks before fall overseeding. Dimension also works well when there is less pressure from *Poa* infestations. Pendulum, Barricade, and Dimension applied in fall followed by another December timing after frost work well in non-overseeded turf and bare ground. In overseeded turf, Barricade and Dimension should be applied after all overseeded grasses are well established after frost and bermudagrass is dormant.

## Controlling Problem Winter Weeds

- ▶ Preemergence herbicides
  - ▶ Grass weed herbicides
    - ▶ Tower (dimethenamid) [FreeHand], Pennant
  - ▶ Broadleaved weed selective herbicides
    - ▶ Gallery (isoxaben)
  - ▶ Non-selective herbicides (non-overseed)
    - ▶ SureGuard (flumioxazin)
    - ▶ Specticle (indaziflam)
    - ▶ simazine
- ▶ Timing of application
  - ▶ Early November

The “yellow” DNA herbicides also perform well against other winter weeds besides Poa. In non-overseeded turf and bare ground areas, alternative herbicides of different chemistries can be utilized. For Poa control, Sureguard and Specticle perform similar to simazine when a single application to emerging 1-leaf Poa in early November provides season-long control for the remainder of the winter.

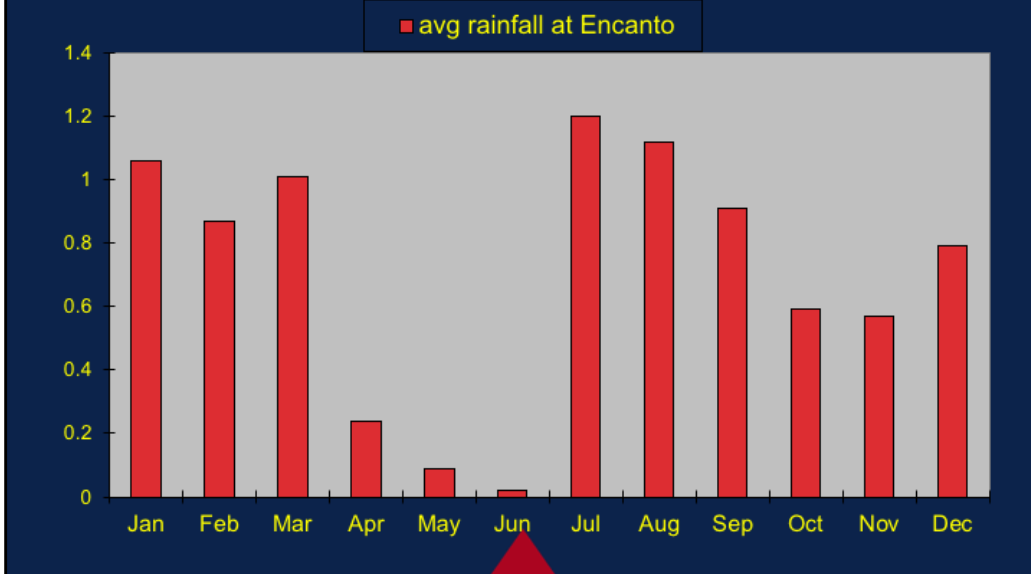
## Optimizing Preemergence Herbicide Performance

- ▶ Winter and monsoon rains
  - ▶ Winter weeds emerge in October-February
    - ▶ Spray in September – January
  - ▶ Summer weeds emerge in February-May
    - ▶ Spray in January – March
  - ▶ Wasted preemergence spray April -June
    - ▶ No rain
- ▶ Apply irrigation water to activate
- ▶ Mechanically incorporate

PRE herbicides can be applied to coincide with the rainfall patterns in the winter and during the summer monsoons.

The next slide illustrates the “typical” rainfall patterns in the low desert to optimize PRE herbicide activity in the winter and during the monsoon rains. The driest period of April through June offer no rain and PRE herbicides won’t get activated unless there is overhead irrigation or mechanical incorporation.

# Optimizing Preemergence Herbicide Performance



Rainfall in the low desert is typical during the fall through winter and the summer monsoon.

## Controlling Problem Summer Weeds

- ▶ Postemergence herbicides
  - ▶ Phenoxy herbicide mixtures
    - ▶ 2,4-D + MCPP + dicamba, etc.
    - ▶ SpeedZone, etc.
    - ▶ Lontrel, Vista, Turflon
  - ▶ ALS-inhibiting herbicides
    - ▶ Celsius (non-overseed)



There are many POST herbicides of which contain the plant-hormone mimic phenoxy herbicides and their relatives – 2,4-D, MCPP, dicamba, fluroxypyr, triclopyr, etc. 2,4-D, MCPP, dicamba are the foundation of commonly used Trimec. The 2,4-D and dicamba related herbicides may be subject to drift and volatilization for off-target plant effects or high temperature restrictions so caution must be exercised to minimize any potential injury or damage to desirable plants. The ALS-inhibiting herbicides such as Celsius may be combined with other POST effective herbicides to offer broad-spectrum weed control.

## Postemergence Herbicides for Difficult to Control Weeds in Turfgrass



- **Trimec 1000** – 2,4-D + MCPP + dicamba
- **4 Speed XT** – 2,4-D + triclopyr + dicamba + pyraflufen
- **4 Speed** – 2,4-D + MCPP + dicamba + pyraflufen
- **Elliptical** – 2,4-D + fluroxypyr + dicamba
- **Vista** – fluroxypyr
- **SpeedZone (& South)** – 2,4-D + MCPP + dicamba + carfentrazone
- **Surge** – 2,4-D + MCPP + dicamba + sulfentrazone
- **TZone** – 2,4-D + dicamba + triclopyr + sulfentrazone
- **Manor** – metsulfuron



There are many POST herbicide combinations that are based on the phenoxy-related herbicides and are mixed with other modes of action herbicides that can often provide quicker observable activity on treated weeds. The addition of pyraflufen, carfentrazone, and sulfentrazone to slower acting herbicides can offer the end-user a rapid foliar burning response following the application. The phenoxy-related herbicides will cause distorted growth with stem and leaf curling within a week or so. The ALS-inhibiting herbicides such as Manor will show foliar yellowing and stunted growth at 10-14 days after treatment.

## Difficult to Control Weeds in Turfgrass

- ▶ Purple nutsedge
- ▶ Strategy for control
  - ▶ Stress weed with frequent mowing
  - ▶ Use **Dismiss CA** in tandem with mowing
  - ▶ 1<sup>st</sup> application of “SU’s” about “4<sup>th</sup> of July” followed 4-6 weeks later in mid-August: **Certainty, Monument, SedgeHammer, Katana, Tribute, Image, or Dismiss South**

A strategy for controlling purple nutsedge is to initiate spraying the ALS-inhibiting herbicides – Certainty, Monument, SedgeHammer, Katana, Tribute Total, Image, or Dismiss South around the “4<sup>th</sup> of July”. A second sequential application should be applied when there is regrowth at 4 to 6 weeks later in mid-August. During spring and into the early summer when nutsedge appears, mow low and frequently to stress the emerging plants. In tandem with mowing, Dismiss CA can be applied up to a total of 12 oz/A of product 2 to 3 times to burn the foliage of the nutsedge. The mowing and burning can weaken the nutsedge prior to the use of the ALS-inhibiting herbicides.

Follow label instructions and do not exceed the limits of the use of the ALS-inhibiting herbicides. Abusive multiple applications may cause the nutsedge to become less susceptible the family of ALS-inhibiting herbicides.



# Herbicide Resistant Weeds



- **Development of herbicide resistance**
  - **Palmer amaranth in Arizona field crops**
  - **First observed glyphosate resistance in 2011**
  - **Rotate classes of herbicides**



The first documented Arizona cases of glyphosate-resistant weeds occurred when Palmer amaranth was observed in field crops in 2011. Dependence on multiple applications of only glyphosate on the same weeds in the same fields resulted in the observed resistant weeds. To avert any future occurrences of weed resistance to herbicides, it is important to mix up and alternate different classes of herbicides to treat tough to control weeds with different modes of action herbicides and using PRE and POST products and pre-mix herbicide products or tank-mixing.

## Current Status of Herbicide-resistant Weeds in Turf

- ▶ *Poa annua* – annual bluegrass
- ▶ ALS-inhibitors
  - ▶ Revolver\*, Image\*, Monument\*, Velocity\*
- ▶ Microtubule inhibitors
  - ▶ Pendulum\*, Barricade\*, Dimension\*
- ▶ PS II inhibitors
  - ▶ Atrazine, simazine
- ▶ EPSP synthase inhibitors
  - ▶ glyphosate

These next 2 slides show that difficult to control weeds that occur in turf and landscapes in Arizona and globally have demonstrated resistance to several commonly used herbicides. Turf managers, landscapers, and applicators should be on the lookout for any developing resistant weeds or weeds that at one time were easier to control and are becoming more tolerant of sprays of the same herbicides and report them to UA weed scientists.

## Current Status of Herbicide-resistant Weeds in Turf

- ▶ *Eleusine indica* – goosegrass
  - ▶ ALS-inhibitors
    - ▶ Revolver\*, Image\*, Monument\*, Velocity\*
  - ▶ Microtubule inhibitors
    - ▶ Pendulum\*, Barricade\*, trifluralin
  - ▶ PS II inhibitors
    - ▶ Sencor\*
- ▶ *Digitaria ischaemum* – smooth crabgrass
  - ▶ ACCase inhibitors
    - ▶ Fenoxaprop (Acclaim\*)
- ▶ *Digitaria sanguinalis* – large crabgrass
  - ▶ ACCase inhibitors
    - ▶ Sethoxydim

# WSSA Herbicide Grouping by Mechanism of Action



The Weed Science Society of America and the global Herbicide Resistance Action Committee together with herbicide manufacturers categorize the commercially available herbicides with a numbering or lettering designation for their modes of action on weeds. End-users can alternate products based the the group numbers visible on product labels and not repeatedly use the same mode of action herbicide that could lead to resistance to the class of herbicides.

## Factors for Potential Herbicide-resistant Weeds in Turf and Landscapes

- ▶ Typical herbicide use patterns in the desert
  - ▶ Over-reliance on "yellow" herbicides in turf

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Summer grass and spurge control				Summer grass and spurge control		<i>Poa</i> control Pre-overseed		<i>Poa</i> control non-overseed		<i>Poa</i> control sequential application

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Summer grass and spurge control					Summer grass and spurge control sequential				Winter weed control	

An example of how turfgrass weeds may develop resistance to herbicides in the low desert is shown where the dinitroaniline (DNA) "yellow" herbicides are frequently used for winter and summer weed control. *Poa annua* is a major target weed in the winter when it is treated in overseeded or non-overseeded turf. Barricade or its relative herbicide, Dimension, is applied 6-8 weeks before overseeding in the fall. If not overseeded, an early October application including Pendulum should be applied when temperatures cool and just before *Poa* germinates. The same PRE herbicides should be applied again in December to extend control into the spring. The same PRE herbicides could be applied in late February to early March for summer grasses such as crabgrass and cupgrass as well as spurge. For extended control throughout the summer, a sequential treatment should be applied in June. The cycle of over-reliance on multiple applications of these PRE herbicides can be alleviated by rotating different families of herbicides with different modes of action.

## Alternative Herbicide Modes of Action for Control of Weeds in Turf and Landscapes

- ▶ Preemergence herbicides
  - ▶ “Yellows” alternated or mixed with
    - ▶ Tower\*, Pennant\*, Bensumec\*, Gallery\*, Ronstar\*
    - ▶ SureGuard\*, Specticle\*, Princep\*
- ▶ Postemergence herbicides
  - ▶ ALS-inhibitors alternated with
    - ▶ Prograss\*, Princep\*, Sencor\*, Dismiss\*, grass herbicides, phenoxies, quinclorac
  - ▶ Glyphosate alternated with
    - ▶ Burndown herbicides

Commercially available herbicides can be alternated with the “yellow” herbicides. A pre-mix combination of Tower plus Pendulum, Freehand, controls annual grass weeds, Pennant is similar to Tower and offers PRE control of yellow nutsedge but not purple. Bensumec may be effective on less infested grass weed populations. Gallery is especially good against most broadleaved weeds such as spurge but not effective against grasses. Ronstar is very effective against goosegrass in the summer.

SureGuard, Specticle, and Princep can control very small emerging Poa at the 1-leaf stage and then provide winter-long Poa control in non-overseeded bermudagrass turf. An application in early November has shown good quality results.

The ALS-inhibiting POST herbicides are frequently used for multiple purposes – eliminate ryegrass for spring transition, clumpy ryegrass control in the winter, purple nutsedge control in the summer, and late fall “PRE” application for Poa control. Depending on the target weed problem, several POST herbicides can be used when timing of application is optimized for most efficacious results. Scouting of sites for small emerging weeds is critical for early stage treatment and best results.

Glyphosate is the most widely used POST herbicide and there are several alternative chemistries that can be applied (see later slide).

## Preemergence Herbicide Control of Grass Weeds in Turf and Landscapes

Herbicide	MOA Group	
Benefin	3	
Dithiopyr Dimension*	3	<i>Poa</i> & crab – fall/spring
Oryzalin Surflan*	3	
Pendimethalin Pendulum*	3	
Prodiamine Barricade*	3	<i>Poa</i> & crab – fall/spring
Trifluralin	3	
Oxadiazon Ronstar*	14	Goosegrass – late spring
Isoxaben Gallery*	21	Broadleaved weeds
Metolachlor Pennant*	15	
Dimethenamid Tower*	15	
Bensulide Bensumec*	8	

The DNA's typically offer effective control of most grasses and some small-seeded broadleaved weeds. To prevent potential development of resistance, if possible, rotate among different modes of action (MOA).

In turf, (Barricade) prodiamine and (Dimension) dithiopyr are used for *Poa* control prior to overseeding. They are again used for crabgrass / cupgrass control in the spring.

Monitoring grass weed populations may allow changing chemistries or utilizing POST applications of other herbicides.

## PRE / POST Herbicide Control of Weeds in Turf and Landscapes

Herbicide		MOA Group
Indaziflam	Specticle*	29
Flumioxazin	SureGuard*	14
Simazine	Princep*	5

Control of *Poa* in dormant non-overseeded bermudagrass now has effective options by using Specticle\* (indaziflam) or SureGuard\* (flumioxazin). Both are effective against small, 1-2 leaf sized *Poa*, and controls most weeds through the winter and well into the spring when applied in early November.

All 3 of the PRE /POST options represent different modes of action and can be integrated into a strategy where overseeding may be skipped occasionally.



## Postemergence Herbicide Control of Weeds in Turf and Landscapes

Grass Herbicides		MOA Group	
Clethodim	Envoy*	1	Landscape
Sethoxydim	Segment*	1	Landscape
Fluazifop	Fusilade*	1	Landscape
Ethofumesate	Prograss*	8	Turf
Amicarbazone	Exonerate*	5	Turf
Methiozolin	PoaCure*	30	Turf
Quinclorac	Drive*, etc.	4	Turf

Broadleaved Turf Herbicides		MOA Group	
2,4-D		4	
Dicamba	Vanquish*, etc.	4	
Clopyralid	Lontrel*	4	
Fluroxypyr	Vista*	4	
Triclopyr	Turflon Ester*	4	
Sulfentrazone	Dismiss CA*, Q4 Plus*, etc.	14	
Carfentrazone	QuickSilver*, SpeedZone*, etc.	14	

Different modes of action can be used against various grass and broadleaved weeds, especially in turf.

The grass herbicides, “FOPS” and “DIMS” are very good against bermudagrass growing in ornamentals.

Prograss\* (ethofumesate), Xonerate\* (amicarbazone), and PoaCure\* (methiozolin) are being further investigated for use against *Poa* in the desert turf on golf courses.

Quinclorac (Drive\*, etc.) products have been effective against crabgrass and southwestern cupgrass in turf.

The broadleaved turf herbicides generally are pre-mixed by various companies and are very good in overseeded winter turfgrasses.

Temperature restrictions limit use on warm-season turf due to some phytotoxicity.

## ALS-inhibiting Postemergence Herbicides in Turf

Herbicide	MOA Group
Foramsulfuron (Revolver*, Tribute Total*)	2
Trifloxysulfuron (Monument*)	2
Sulfosulfuron (Certainty*)	2
Flazasulfuron (Katana*)	2
Halosulfuron (SedgeHammer*, Tribute Total*)	2
Metsulfuron (Manor* & others)	2
Rimsulfuron (TranXit*)	2
Iodosulfuron (Celsius*)	2
Bispyribac-sodium (Velocity*)	2
Penoxsulam (Sapphire*)	2
Imazaquin (Image*)	2
Imazethapyr (Dismiss South*)	2

The most diverse and broadspectrum ALS-inhibiting herbicides are being adopted for many uses year-around in turf.

Low doses Monument\*, Certainty\*, Katana\*, Manor\*, Tribute Total\*, and TranXit\* can be used for spring transition to remove overseeded ryegrasses from bermudagrass.

Higher rates of Monument\*, Certainty\*, Katana\*, and Tribute Total\* are very effective against purple nutsedge in the late summer.

The ALS-inhibitors control other weeds and undesirable vegetation in turf, overseeded and non-overseeded, so their use is extended over the winter, spring, summer, and fall.

The potential for herbicide resistance is very possible for this mode of action family.

## Postemergence Non-selective Herbicide Control of Weeds in Turf and Landscapes

Herbicide		MOA Group
Glyphosate	Roundup*, etc.	9
Glufosinate	Finale*	10
Diquat	Reward*	22
Pelargonic acid	Scythe*	26

Non-selective POST herbicides can be effective on non-overseeded bermudagrass in the winter.

Glyphosate may cause injury if bermudagrass is showing any green.

Reward and Scythe cause an immediate burndown of treated weeds.

Multiple applications may be needed if winter rains bring on more germinating broadleaved weeds and *Poa*.

# Glyphosate Products



There are many glyphosate-containing products available for professional, commercial, and residential/homeowner uses. The concentrations of the active ingredient or the acid equivalent vary in all of different formulations and there are combinations with other herbicides to broaden the utility and weed spectrum of the products. The addition of imazapic and imazapyr extend the residual activity of the product to last months against most weeds. The addition of diquat enhances the rapid response and exhibits foliar burning effects.

# Glyphosate Products



73% ammonium salt +  
diquat 2.9%



1% IPA salt +  
pelargonic acid 2% +  
imazapic 0.017%



1% IPA salt +  
pelargonic acid 2%



0.96% IPA salt +  
pelargonic acid 1%

Many "ready-to-use" formulations enable the end-user to mix very simply or to "buy and squirt".

# NON-Glyphosate Products



MCPA +  
quinclorac +  
dicamba +  
sulfentrazone



penoxsulam +  
sulfentrazone +  
2,4-D +  
dicamba

Recently, the "Roundup" name became a marketing brand name for retail consumers. The "Roundup" products now include non-glyphosate containing herbicides that can be used directly on home lawns for controlling broadleaved weeds, nutsedge, and crabgrasses. Always read the label carefully before using any herbicides on any site.

## Glyphosate Fact Sheet

- ▶ Herbicide that kills both broadleaved plants and grasses when applied to the leaves
  - ▶ Non-selective so it kills most plants
  - ▶ Used in U.S. since 1974 in agriculture, forestry, lawns, gardens, industrial sites, aquatics
- ▶ Formulated as an amber-colored liquid or a solid wettable, soluble granule.
  - ▶ Often mixed with other herbicides and includes adjuvants to enhance performance.
- ▶ Prevents plants from making proteins.
  - ▶ Specifically stops an enzyme needed for making amino acids found only in plants and bacteria

<http://npic.orst.edu/factsheets/glyphogen.html#products>

There have been frequent and multiple mis-representations of glyphosate as an herbicide. The next 4 slides offer facts about glyphosate to assist in alleviating fears about its characterization and uses.

The fact sheet about glyphosate was compiled by the National Pesticide Information Center at the Oregon State University Extension Services.

## Glyphosate Fact Sheet

- ▶ Exposure to glyphosate may occur when using it
  - ▶ Direct contact on skin, into eyes, or breathe it in
  - ▶ Swallow if contaminated hands contact food or smoking
  - ▶ Touching plants that are still wet with spray
  - ▶ Glyphosate doesn't vaporize after spraying
- ▶ Pure glyphosate active ingredient is low in toxicity
  - ▶ Other inert ingredients may cause eye or skin irritation or injury. Breathing spray mist may cause nose and throat irritation. Swallowing spray products can cause increased saliva, burning sensation in mouth and throat, nausea, vomiting, and diarrhea.

<http://npic.orst.edu/factsheets/glyphogen.html#products>



## Glyphosate Fact Sheet

- ▶ Exposure to glyphosate may occur when using it
  - ▶ In humans, glyphosate does not pass through skin with direct contact
  - ▶ If absorbed or ingested, glyphosate passes through the body quickly via urine and feces
- ▶ Pure glyphosate active ingredient is low in toxicity
  - ▶ High doses administered to lab animals may suggest glyphosate carcinogen potential, developmental and reproductive effects in rats.
  - ▶ No links to asthma or other diseases found nor increased sensitivity to children
  - ▶ No direct toxicity effects on fish and wildlife

<http://npic.orst.edu/factsheets/glyphogen.html#products>

# Glyphosate Fact Sheet

- ▶ Glyphosate in the environment
  - ▶ Binds tightly to soil. Broken down by bacteria in soils and rate depends on climate and type of soil.
  - ▶ Not likely to leach into groundwater because of soil binding.
  - ▶ Half-life in dead leaves 8-9 days
- ▶ Henderson, A. M.; Gervais, J. A.; Luukinen, B.; Buhl, K.; Stone, D. 2010. *Glyphosate General Fact Sheet* National Pesticide Information Center, Oregon State University Extension Services.  
<http://npic.orst.edu/factsheets/glyphogen.html>.

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## Postemergence Non-selective Herbicide Control of Weeds in Turf and Landscapes

Herbicide		MOA Group
Glyphosate	Roundup*, etc.	9
Glufosinate	Finale*	10
Diquat	Reward*	22
Pelargonic acid	Scythe*	26

There are several alternative POST non-selective herbicides that be utilized as substitutes to glyphosate.

## Herbicide Control of Weeds in Turf and Landscapes

- ▶ **Preemergence herbicides**
  - ▶ Follow label rates
    - ▶ Do NOT cut rates
    - ▶ Apply sequential applications
  - ▶ Rotate chemistries
- ▶ **Postemergence herbicides**
  - ▶ Treat young weeds
  - ▶ Follow label rates
  - ▶ Rotate chemistries
  - ▶ Use tank-mixes
- ▶ **Integrate PRE and POST herbicides in a management strategy**

PRE and POST herbicides should be integrated into a strategy to manage weeds in turf and landscapes.

Use herbicides at recommended label rates and don't cut rates.

When recommended to apply multiple applications, follow the correct timing of applications for maintaining season-long control.

Rotate chemistries among the different modes of action.

For POST applications, treat small-sized and younger weeds and not weeds that have matured, hardened-off, and set flowers and seeds.

Again, use chemistries that represent different modes of action and utilize tank-mixes or pre-mix products.

## Prevent and Monitor Weeds in Turf and Landscapes for Herbicide Resistance

- ▶ Culturally manage turf and landscapes
  - ▶ Encourage vigorous and healthy plants
  - ▶ Efficiently manage water
- ▶ Rotate available herbicide chemistries
  - ▶ Use label rates
  - ▶ Don't cut rates

In summary, herbicide resistance is not yet documented in desert turf and landscapes. The potential exists but diligent monitoring and utilizing cultural practices can prevent the onset of resistance. Many herbicide alternatives exist but learning to integrate them into a strategy can lessen the pressure on the few existing reliable herbicides used commonly today.



# Turfgrass Research and Extension

<http://turf.arizona.edu>

