



# Herbicides

Barricade, Monument and Tenacity

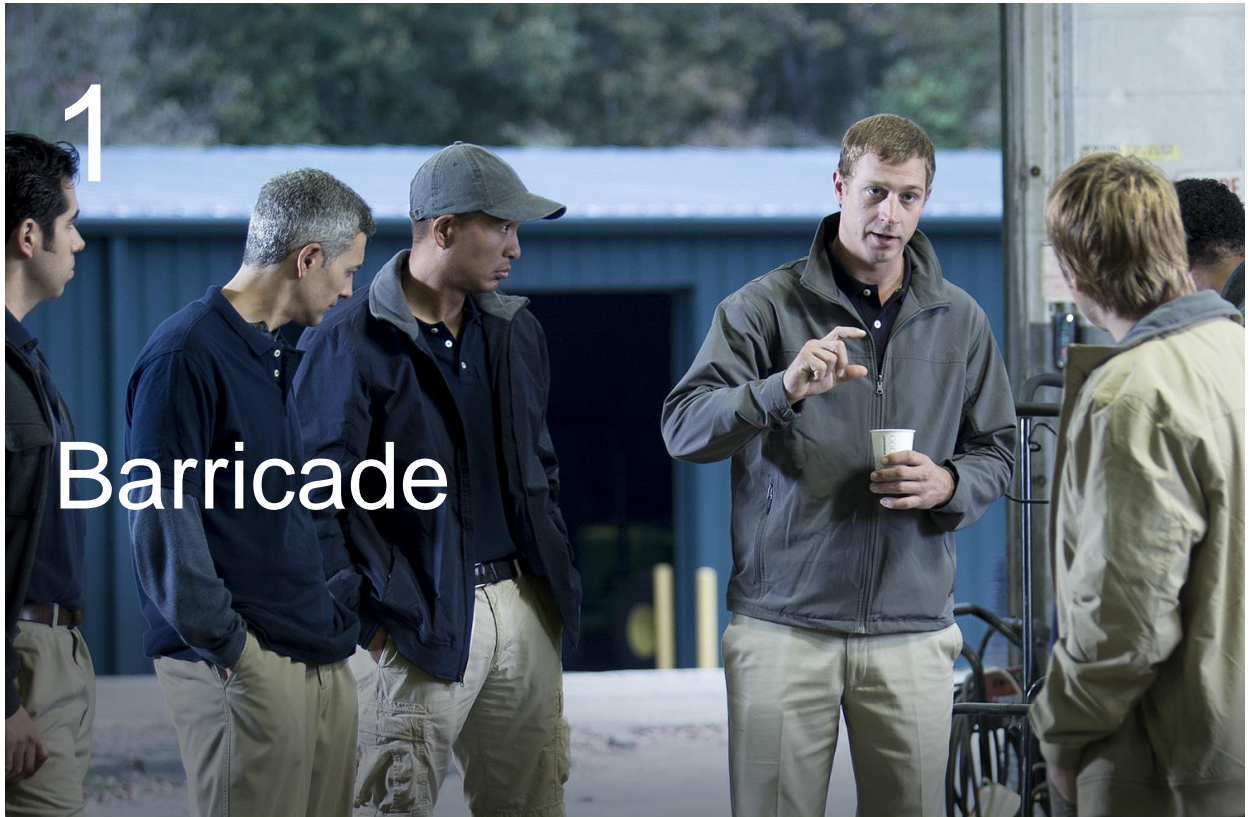
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**Sowmya (Shoumo) Mitra, Ph.D.**  
Head Turf, Landscape & Ornamentals, Syngenta Asia Pacific Pte Ltd.

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# Barricade



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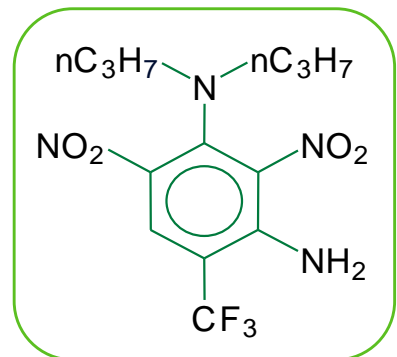
 **Barricade®**  
Herbicide

Longest  
lasting  
Pre-emergent  
herbicide

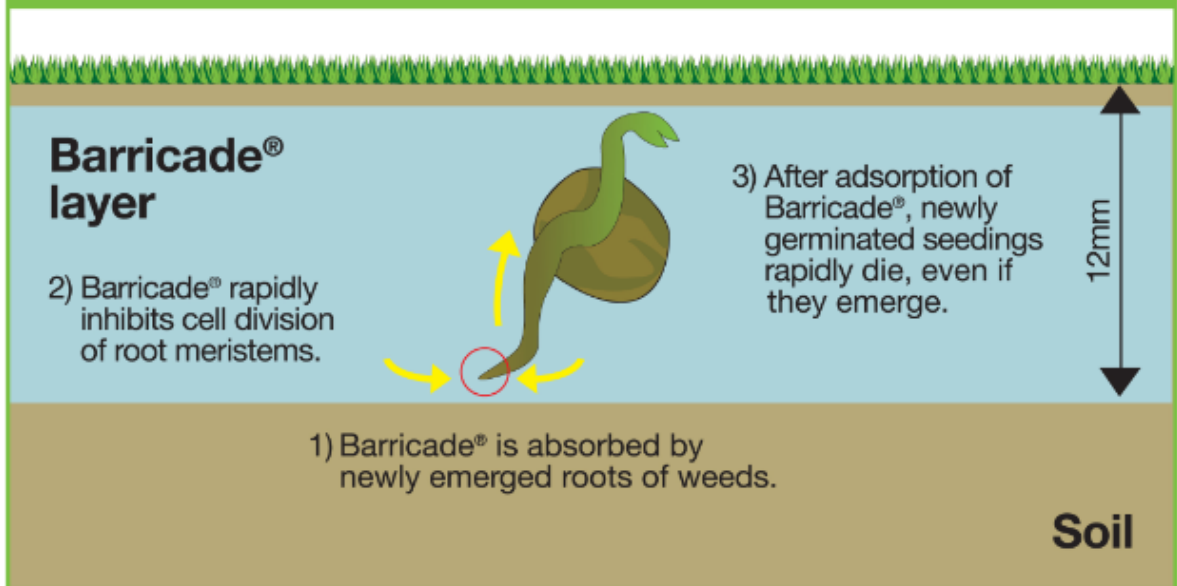
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## Active ingredient - Prodiamine

- **Common Name**  
Prodiamine
- **Chemical Family**  
Dinitroaniline (DNA)
- **Other Members of This Family**  
Treflan (trifluralin)  
Balan (benefin)  
Surflan (oryzalin)  
Pendulum (pendimethalin)  
XL (benefin + oryzalin)  
Team (benefin + trifluralin)



## How does Barricade® work?



## Mode of action

Member of the dinitroaniline (DNA) class of herbicides

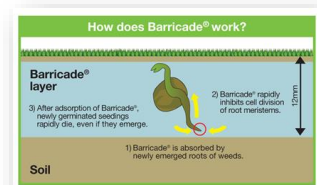
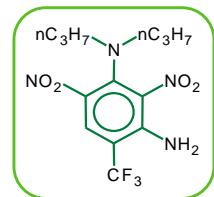
Inhibition of cell division by preventing microtubule assembly in mitosis

Areas of rapid cell division are in the shoots and roots of newly germinated weed seeds

Barricade is not translocated in the plant so weed seeds must contact the herbicide zone

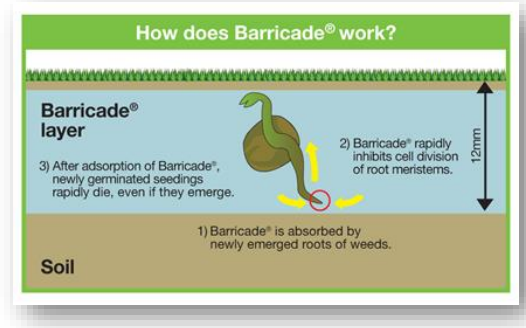
Metabolism

Rapidly degraded



## Behavior in soils

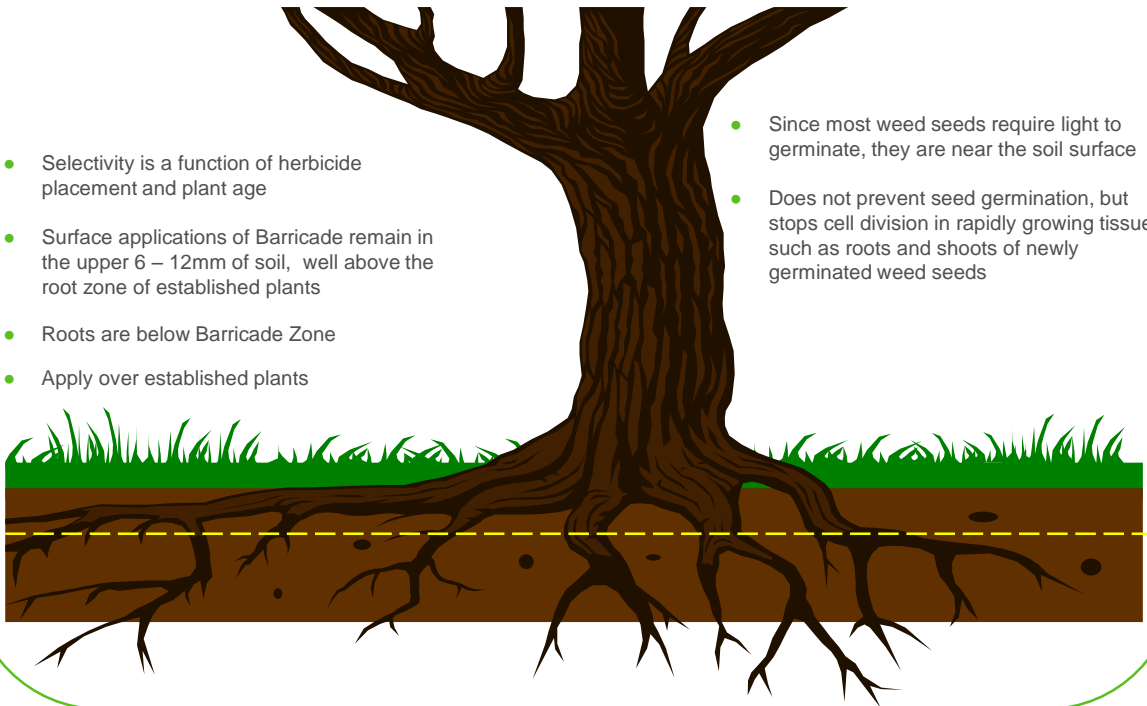
- **Adsorption**  
Strong soil adsorption
- **Photodegradation**  
Moderate (nil after incorporation)
- **Persistence**  
Half-life 45 to 120 days
- **Mobility**  
Not leached
- **Volatility**  
Losses from prolonged exposure on soil only
- Breakdown in the soil slow = long residual  
Microbial activity – aerobic and anaerobic



## Barricade® Selectivity – Maximum plant safety

- Selectivity is a function of herbicide placement and plant age
- Surface applications of Barricade remain in the upper 6 – 12mm of soil, well above the root zone of established plants
- Roots are below Barricade Zone
- Apply over established plants

- Since most weed seeds require light to germinate, they are near the soil surface
- Does not prevent seed germination, but stops cell division in rapidly growing tissue such as roots and shoots of newly germinated weed seeds





## Barricade® – Outstanding residual pre-emergence weed control

**Longest residual and most consistent full-season pre-emergence weed and grass control**

**Unique non-staining formulation**

Clear advantage over other herbicides producing a distinct unsightly yellow coloration on the turf

**Can apply in the Fall to control crabgrass all through the following growing season**

**Offers low rate, season long control of 30 grass and broadleaf weeds, including crabgrass, goosegrass and *Poa annua***

## Broad spectrum weed control with Barricade®



**Annual sedges**  
*Cyperus compressus*



**Crabgrass**  
*Digitaria ischaemum*



**Goosegrass**  
*Eleusine indica*

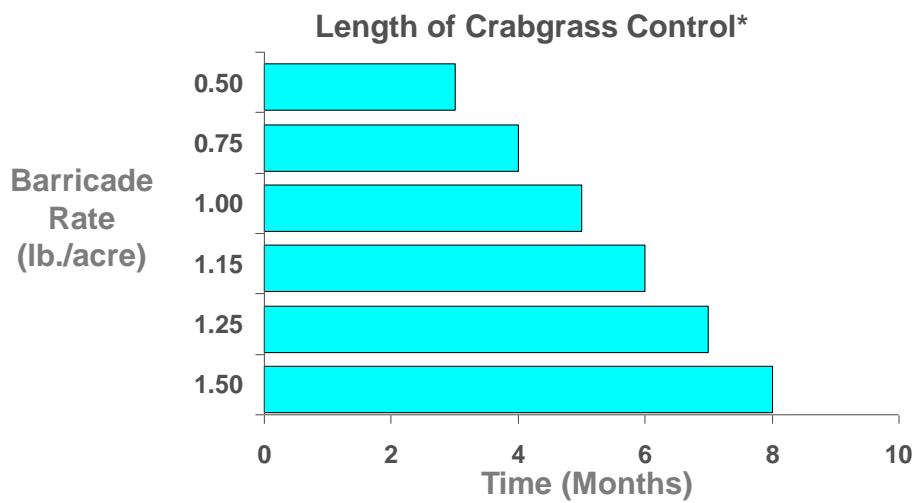


**Prostrate Spurge**  
*Euphorbia supina*



**Diamond Flower**  
*Oldenlandia corymbosa*

## Excellent residual control with Barricade®



\*Length of control varies by region. This table is an average.



5 months weed control with Barricade®

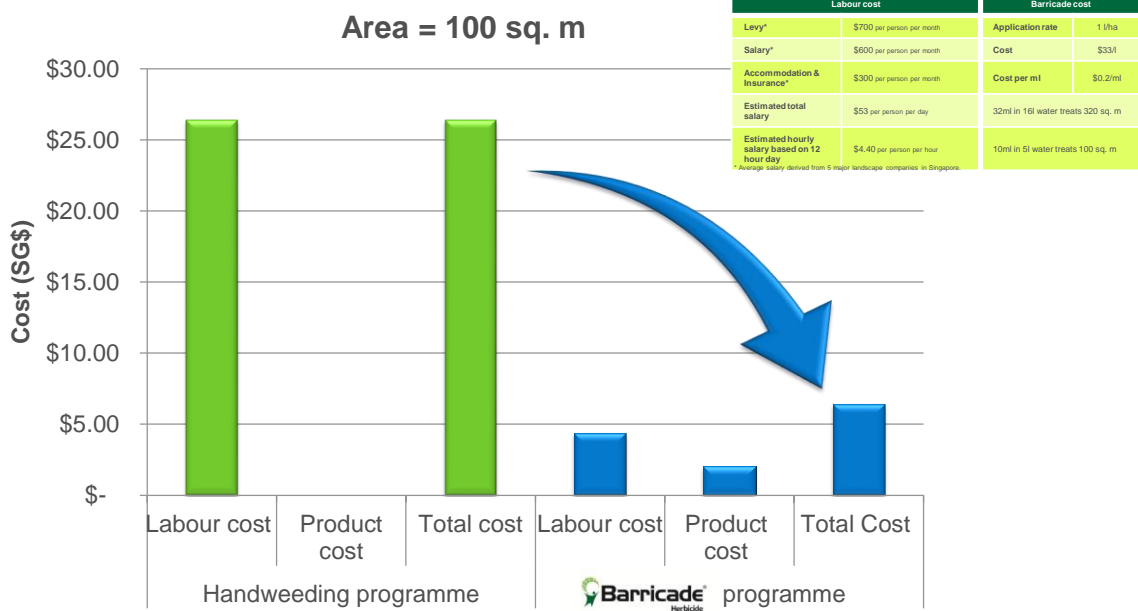
## Barricade Pre-emergent weed control in shrub beds



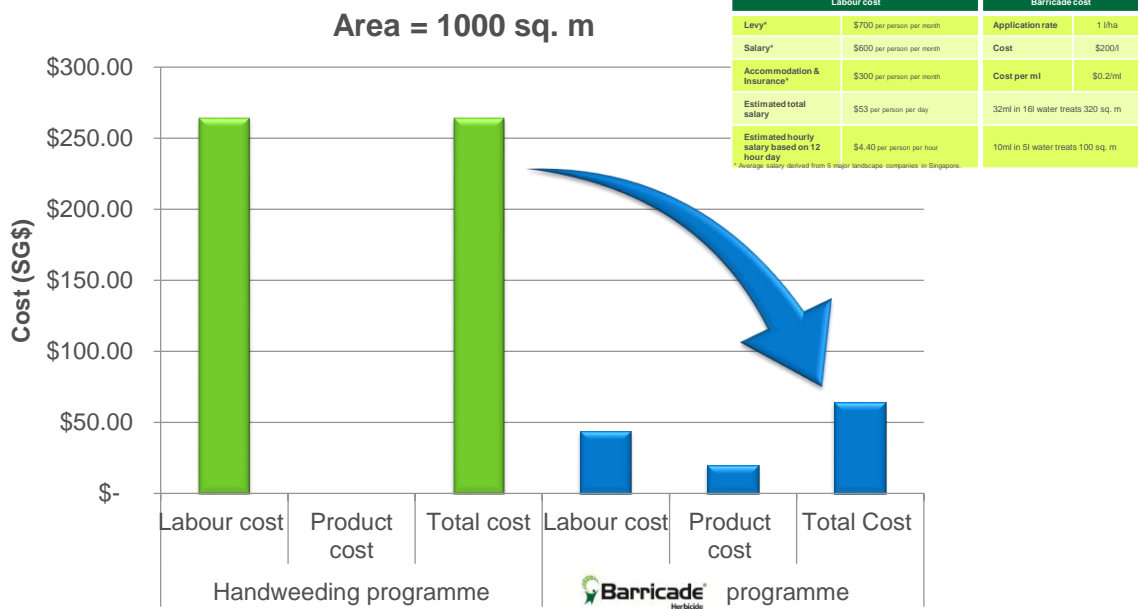
Excellent weed control in shrub bed 1 month after the application of Barricade at the 3l/ha rate



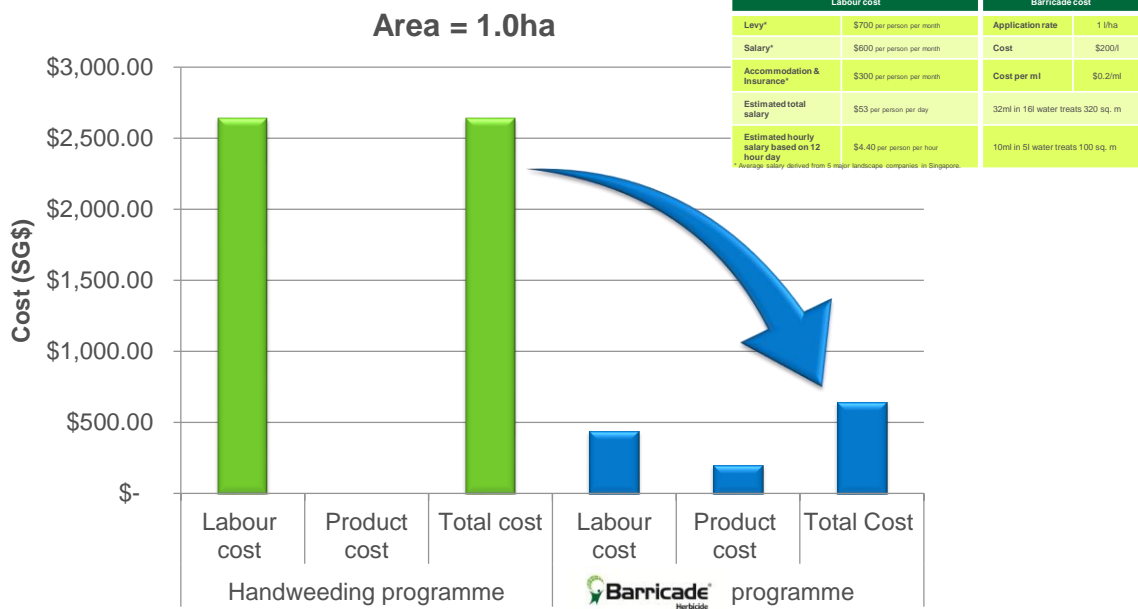
## Barricade® Productivity – Improves efficiency and saves costs



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## BARRICADE KEY BENEFITS

**Improves productivity by reducing the need for hand weeding**

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**Excellent pre-emergence herbicide of tough weeds like sedges**

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**Long residual weed control in landscape areas**

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**Established plants like trees and shrubs are unaffected, as their roots remain below the herbicides zone**

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# Monument

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**Monument<sup>®</sup> 75WG**  
Herbicide

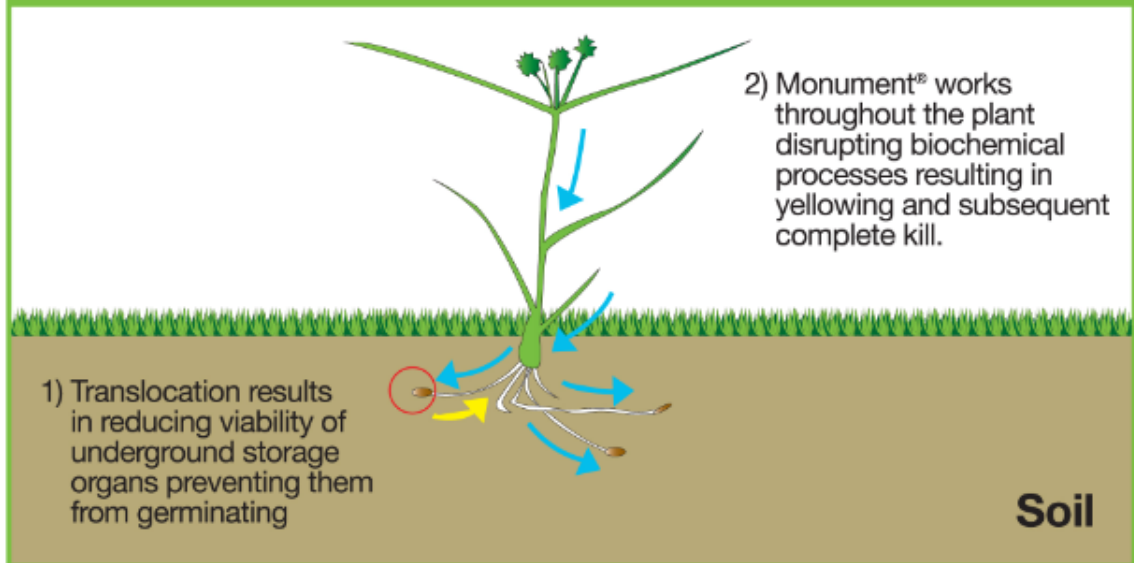
**Unsurpassed post  
emergent weed control  
in carpet grass  
(*Zoysia matrella*)**

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## Challenges of handweeding sedges



## How does Monument® work?



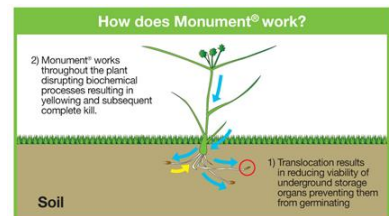
## Monument uptake, mode of action & selectivity

**Active ingredient :** Trifloxysulfuron sodium

**Uptake:** Foliage & roots

**Mode of Action:** ALS inhibitor (amino biosynthesis blocker)

**Selectivity:** Differential uptake of turf and weeds and translocation



## Broad spectrum control with Monument

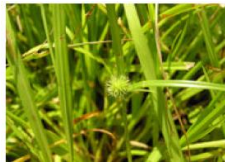
### Controls.....



Annual sedge  
*Cyperus compressus*



Yellow nutsedge  
*Cyperus esculentus*



Green kyllinga  
*Kyllinga brevifolia*



Cocks-comb  
kyllinga  
*Kyllinga squamulata*

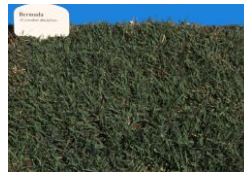


Mimosa  
*Mimosa spp.*

### In.....



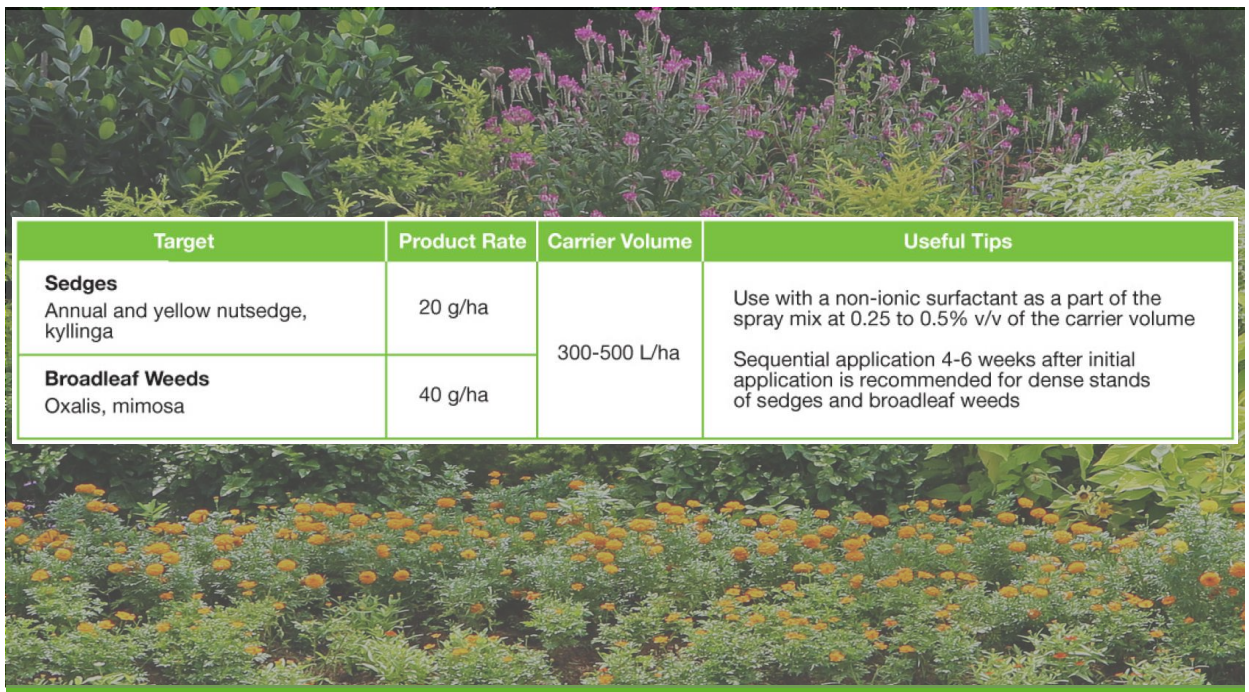
Zoysiagrass  
*Zoysia spp.*



Bermudagrass  
*Cynodon spp.*



## Monument 75WG easy to apply



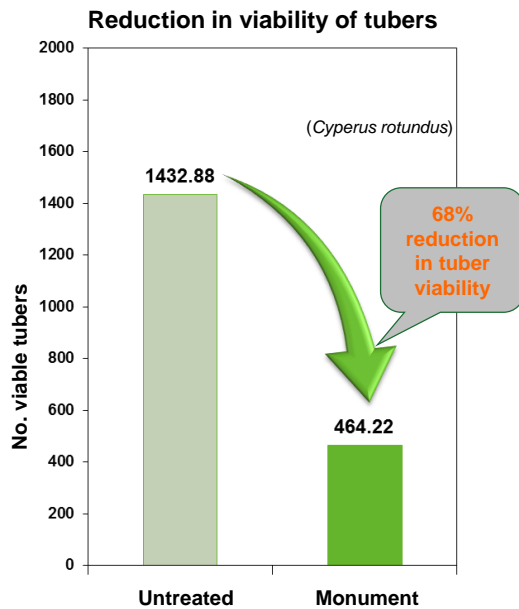
Target	Product Rate	Carrier Volume	Useful Tips
<b>Sedges</b> Annual and yellow nutsedge, kyllinga	20 g/ha	300-500 L/ha	Use with a non-ionic surfactant as a part of the spray mix at 0.25 to 0.5% v/v of the carrier volume  Sequential application 4-6 weeks after initial application is recommended for dense stands of sedges and broadleaf weeds
<b>Broadleaf Weeds</b> Oxalis, mimosa	40 g/ha		

## Excellent sedge control with Monument

### Sedge control in carpet grass



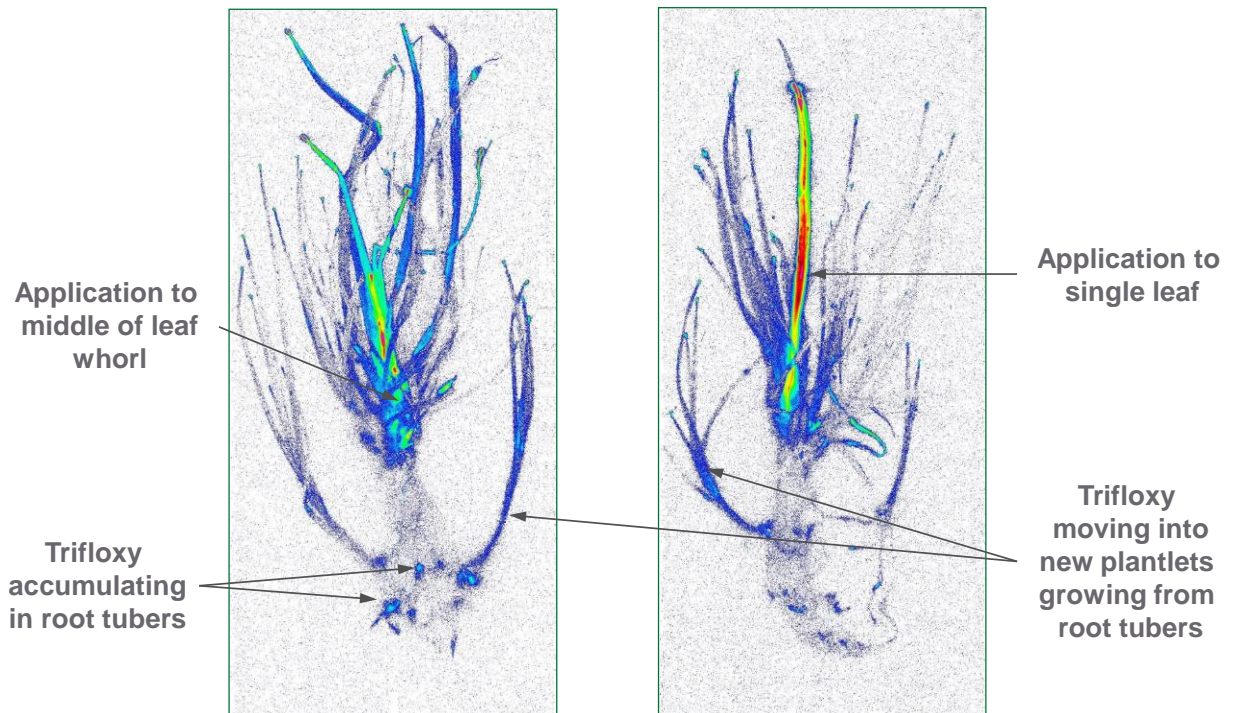
## Monument controls tubers of sedges as well!



Sequential applications 4 to 6 weeks after first application applications significantly reduced tuber production and germination



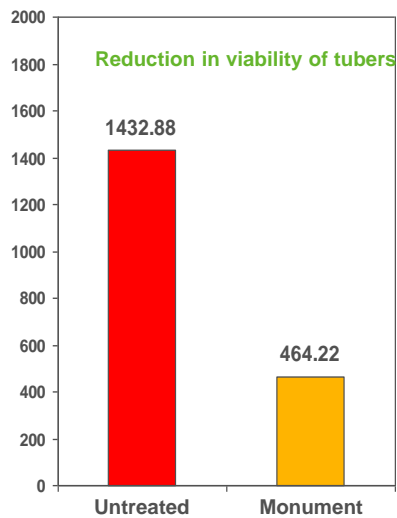
## Biokinetics - Monument moving to Sedge regrowth





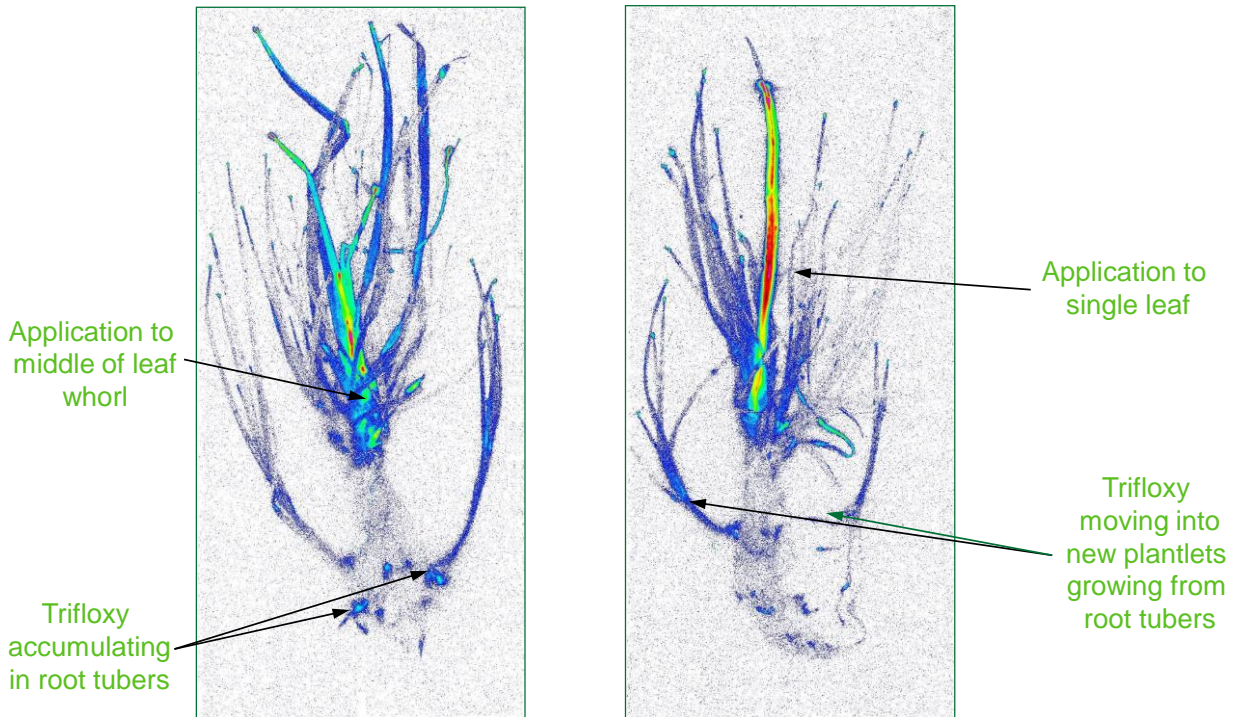
## Management of Sedge (*Cyperus rotundus*)

Sequential applications 4 to 6 weeks after first application applications significantly reduced tuber production and germination

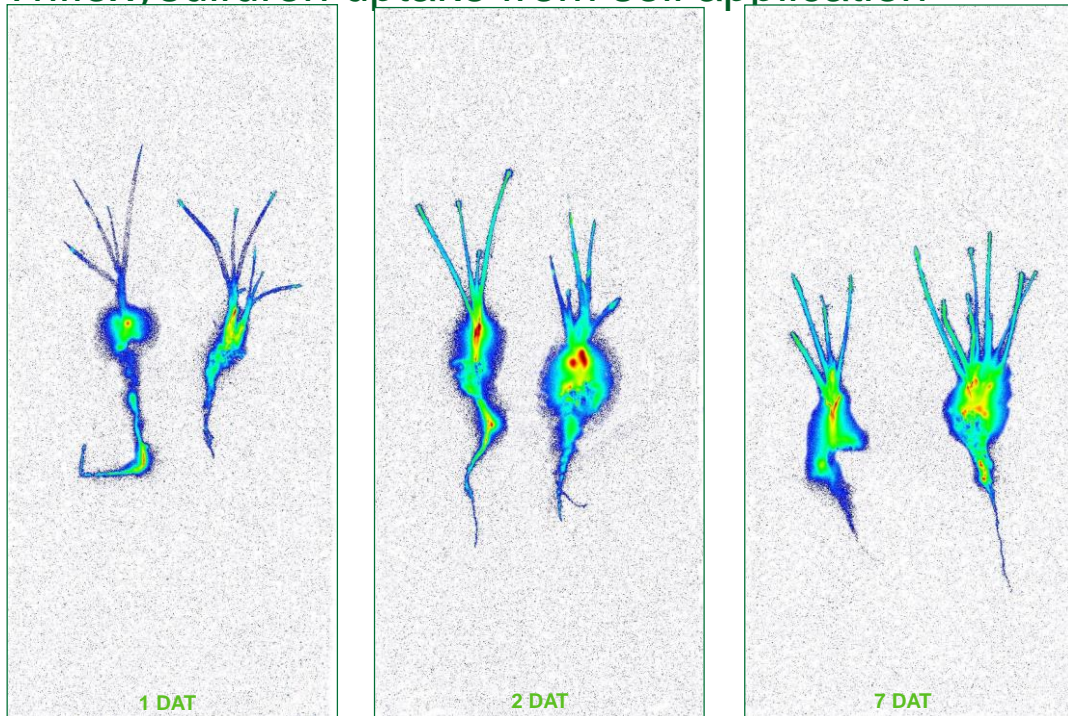




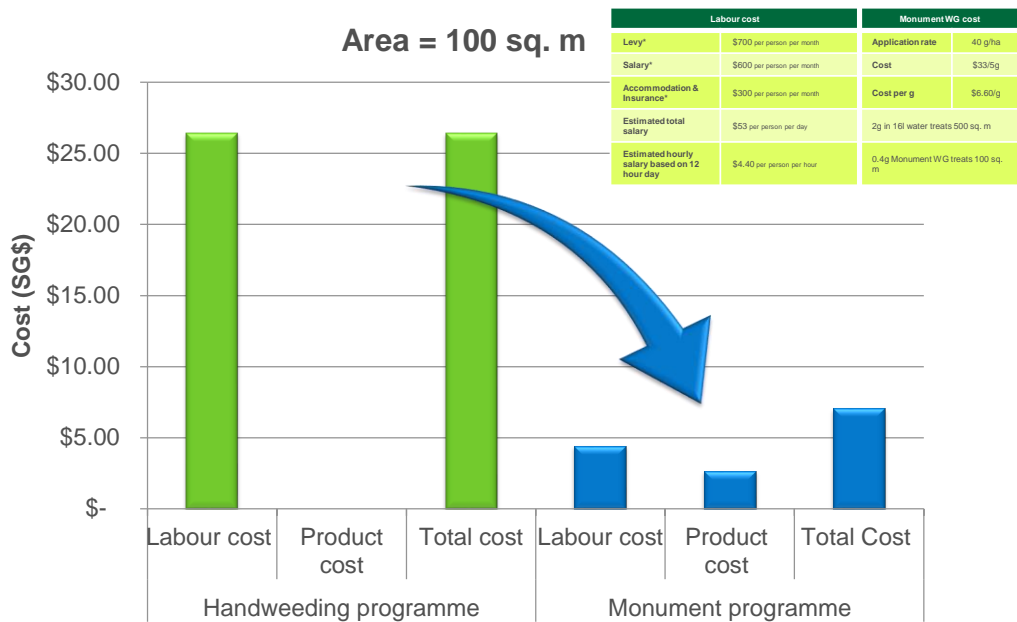
## Trifloxysulfuron moving to sedge regrowth



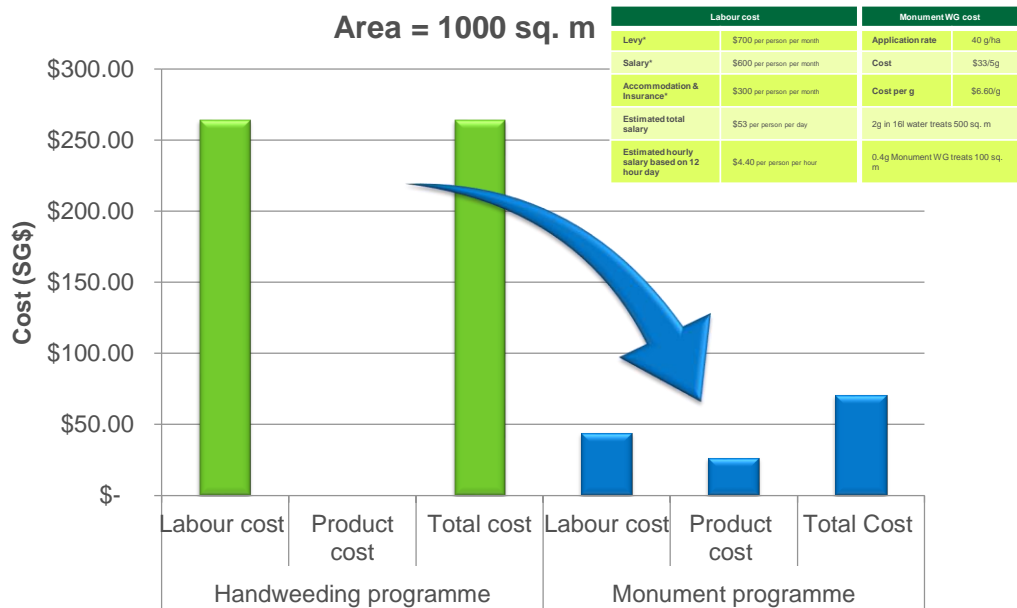
## Trifloxysulfuron uptake from soil application



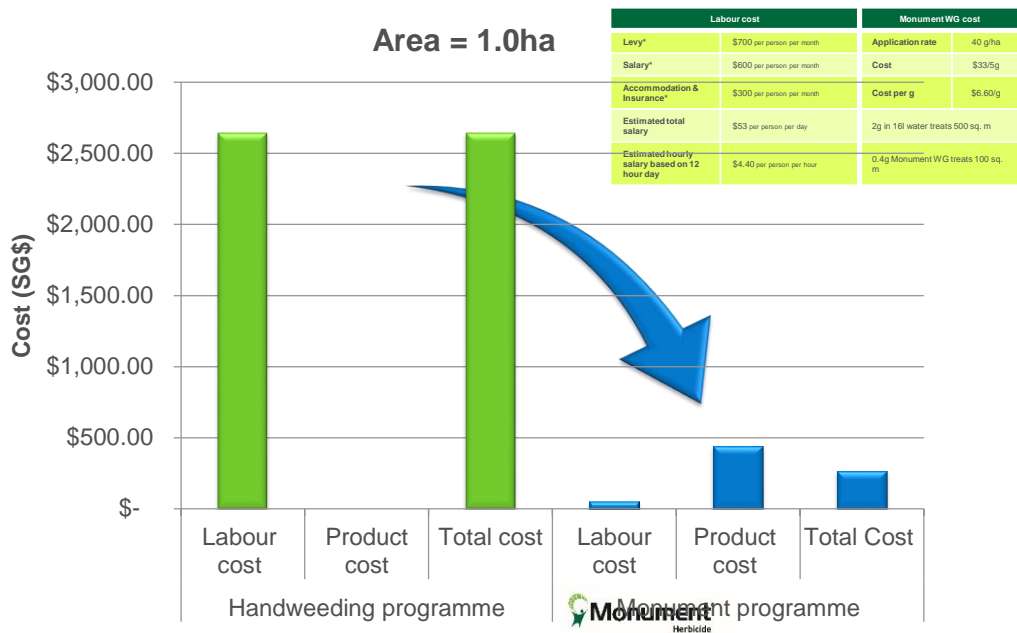
## Monument® Productivity – Improves efficiency and saves cost



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## MONUMENT KEY BENEFITS

**Increased productivity by reducing the need for handweeding**

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**Excellent selective post-emergent control of sedges and broadleaved weeds in carpet grass**

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**Effective control of sedges at low rate**

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**Easy to apply through knapsack sprayer for spot treatment**



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Tenacity

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## What is Tenacity?

- Pre- and/or post-emergent control of 11 monocot and 35 dicot weeds
- Active ingredient: mesotrione
- New chemistry class – triketones
- Foliar and root uptake



## Tenacity

Is rapidly degraded in soil by microorganisms, ultimately to carbon dioxide

Factors that effect microbial growth such as low moisture and low temperatures will slow degradation

Soil half-life ranges from 5 to 15 days with an average field half-life of 9 days

Water solubility is 15g/L at 20° C, pH 6.9

## The Inspiration for Tenacity Plant Technology

Mesotrione, the active ingredient in Tenacity, was discovered during an attempt to mimic the natural herbicides (allelochemicals) secreted by some plants



### *Allelochemicals*

Natural compounds secreted by plant roots which kill weeds and prevent competition

## The Discovery

A Syngenta biologist in California made an interesting observation

there were unexpectedly few plants growing under the bottle brush (*Callistemon citrinus*) plants in his garden

The extent to which weeds were suppressed was out of all proportion to what he expected from plant shading

*Callistemon citrinus*  
(Bottlebrush)

Native to Australia  
Introduced into many  
countries as an ornamental  
Widespread in California and  
Florida





## The Inspiration

The discovery of the allelochemical, leptospermone, was exciting, as it had some very interesting properties

Good foliar activity, in addition to being soil active (as expected from a root exudate)

Well tolerated by some crops

Controlled a wide range of weeds

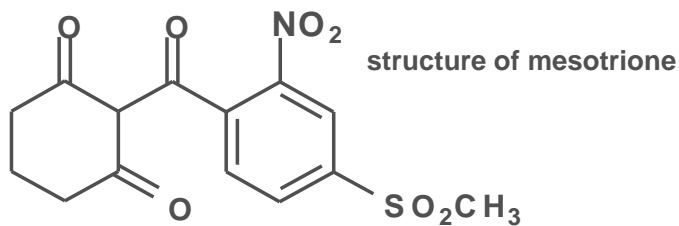
BUT, 4.5 lbs/A was required for weed control

Through a series of modifications and optimisations of the “backbone” of the leptospermone molecule, a series of analogues were produced

Mesotrione is a member of the triketone family of herbicides with broad-spectrum, selective, post-emergence and pre-emergence control of broad-leaved and grass weeds

Mesotrione acts by inhibition of HPPD, an essential enzyme in the biosynthesis of plastoquinone, a co-factor which is required for carotenoid production

**HPPD = p-Hydroxyphenylpyruvate dioxygenase**



## Tenacity

Tenacity is absorbed by plants through the roots, shoots and leaves.

Within 24 hours Tenacity is distributed throughout the plant by both xylem and phloem translocation (Systemic)

Foliar symptoms appear in sensitive weeds in 5 to 7 days as bleaching of the new growth



## Tenacity

Newly germinated weeds absorb Tenacity through the roots and shoots and fail to emerge or die shortly after emergence

Tolerant turfgrass species quickly metabolize Tenacity and are unaffected.



## Precautions

- Bentgrass, *Poa annua*, kikuyugrass, zoysiagrass, seashore paspalum and bermudagrass are sensitive to Tenacity applications. Avoid spraying these turf types unless control and/or injury can be tolerated.
- Do not use on golf course putting greens and maintain a five foot buffer between treated areas and bentgrass or *Poa annua* greens.

## Precautions

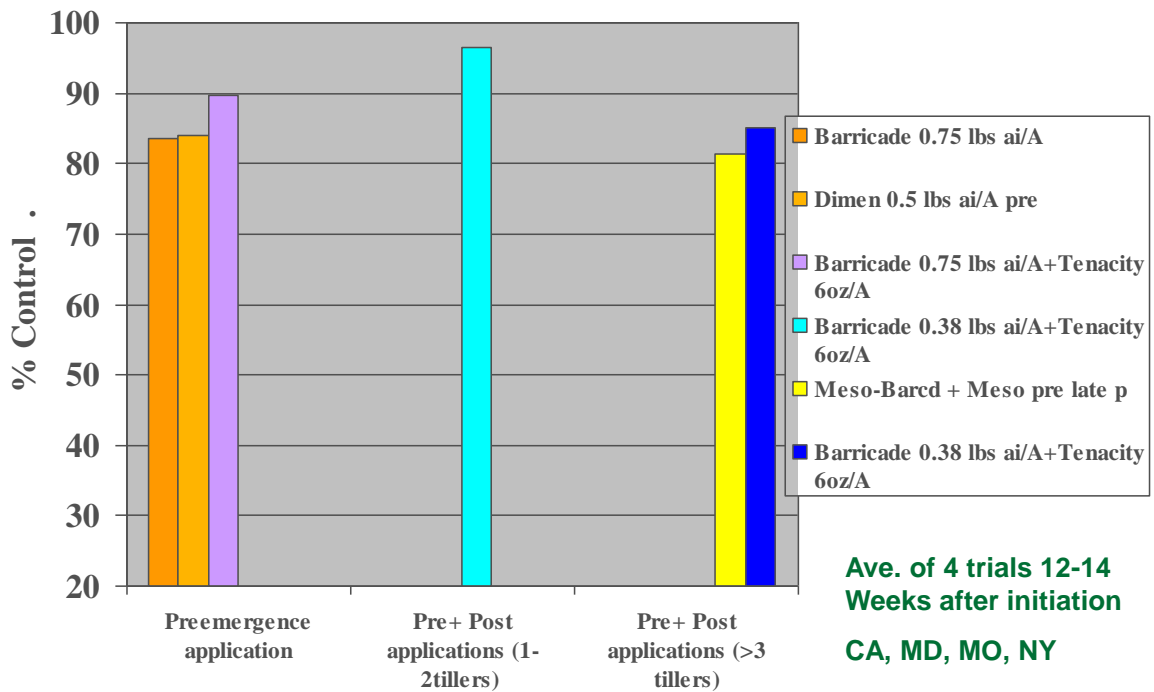
- Clean sprayer thoroughly after an application of Tenacity if same equipment is used to apply products to bentgrass and bentgrass/*Poa annua* turf areas
- Tenacity must be applied at reduced rates (4 fl. oz./A or less) if tank mixed with atrazine, bentazon or simazine.



## Best Practices

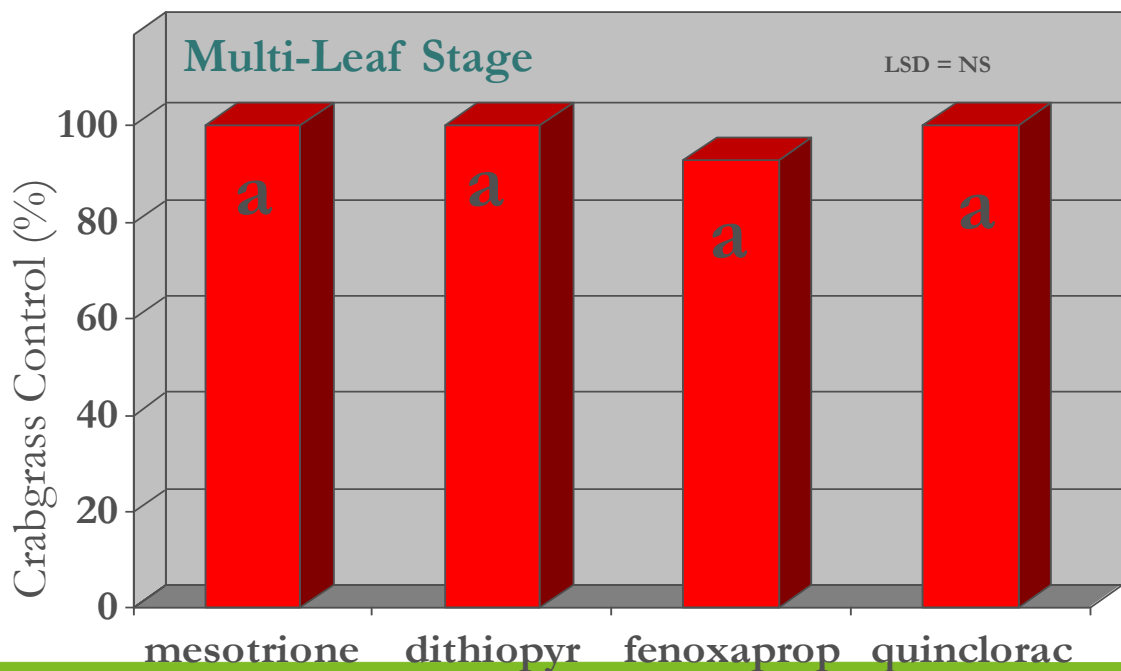
- Weed control with post-emergence applications require a second application after 2 to 3 weeks. Apply to young, actively growing weeds with a NIS type surfactant
- For best post-emergence control apply to less than 4 tiller size crabgrass and goosegrass
- For broad spectrum pre-emergence activity apply with a grass pre-emergence herbicide such as Barricade 65WG Herbicide, except when used for weed control in new seedings

**Pre and Post-emergence applications of Barricade and Tenacity provides good control of crabgrass**



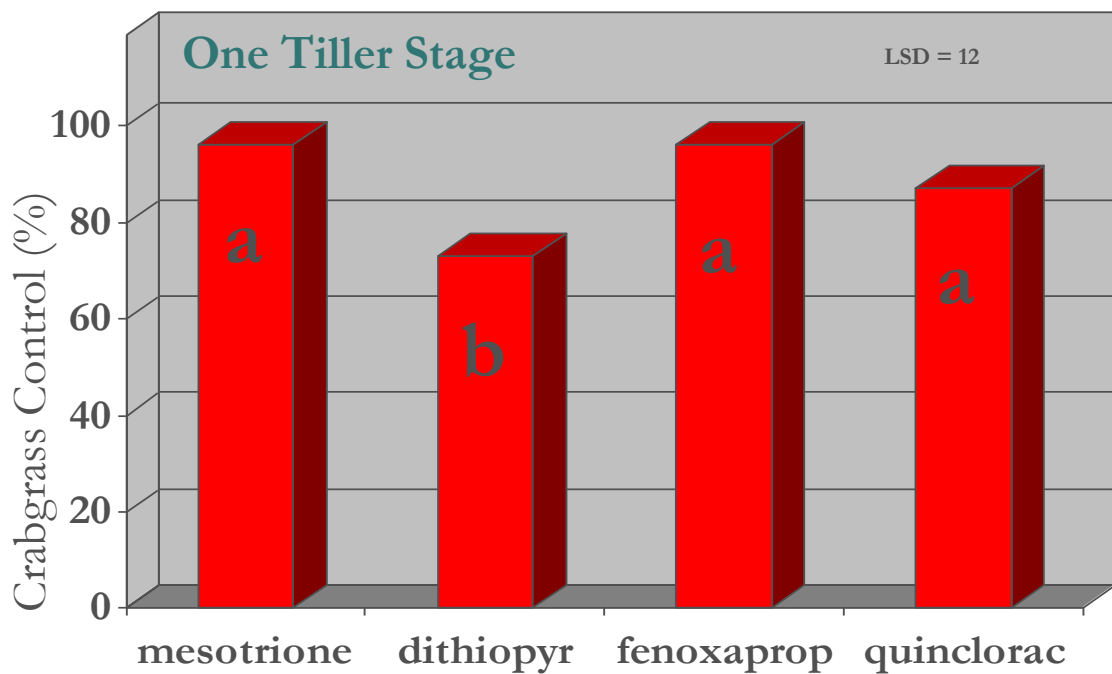
## Tenacity is effective in controlling multi-leaf stage of crabgrass

Crabgrass control at three growth stages in a field experiment, 2007, North Brunswick, NJ.



## Tenacity is effective in controlling one tiller stage of crabgrass

Crabgrass control at three growth stages in a field experiment, 2007, North Brunswick, NJ.



## Tenacity can control Yellow nutsedge



Untreated nutsedge



Mesotrione 0.25lb/A on nutsedge



## Broad Spectrum of Weed Control

**Crabgrass spp.**

**Goosegrass**

**Nimblewill**

**Bentgrass**

**Oxalis**

**Plantain buckhorn**

**Clover spp.**

**Speedwell**

**Lawn burweed**

**Dandelion spp.**

**Canada thistle**

**Yellow nutsedge**

**Yellow foxtail**

**Ground Ivy**

## General Weed Control

### Pre and Post Activity

Pre-applications will require a 2<sup>nd</sup> application – no later than 6-8 weeks

Ex. At seeding, intervals depending on grass type were 4 to 8 weeks.

Post-applications will require a 2<sup>nd</sup> application in 2-3 weeks.

### Foundation Product

Tank-mix with other ai's allows greater flexibility

Ex. Barricade tank-mix applied pre/early post, 2<sup>nd</sup> application at 8-10 weeks.

Dicamba/Fluroxypyr tank-mix for one application on dandelion, clover, plantain etc.

## Summary - Tank-Mix Partners

Tank-mix partners tested in field trials: Barricade, Dicamba, 2,4-D, Carfentrazone, Triclopyr, Atrazine, Simazine, S-Metolachlor, Bentazon, several 3-way Phenoxy combos.

No antagonism observed

Lab testing of these and several others for compatibility with Tenacity is on-going











