



Agriculture Division of DowDuPont

Challenges and Opportunities for Developing and Supporting Products for Turfgrass Use

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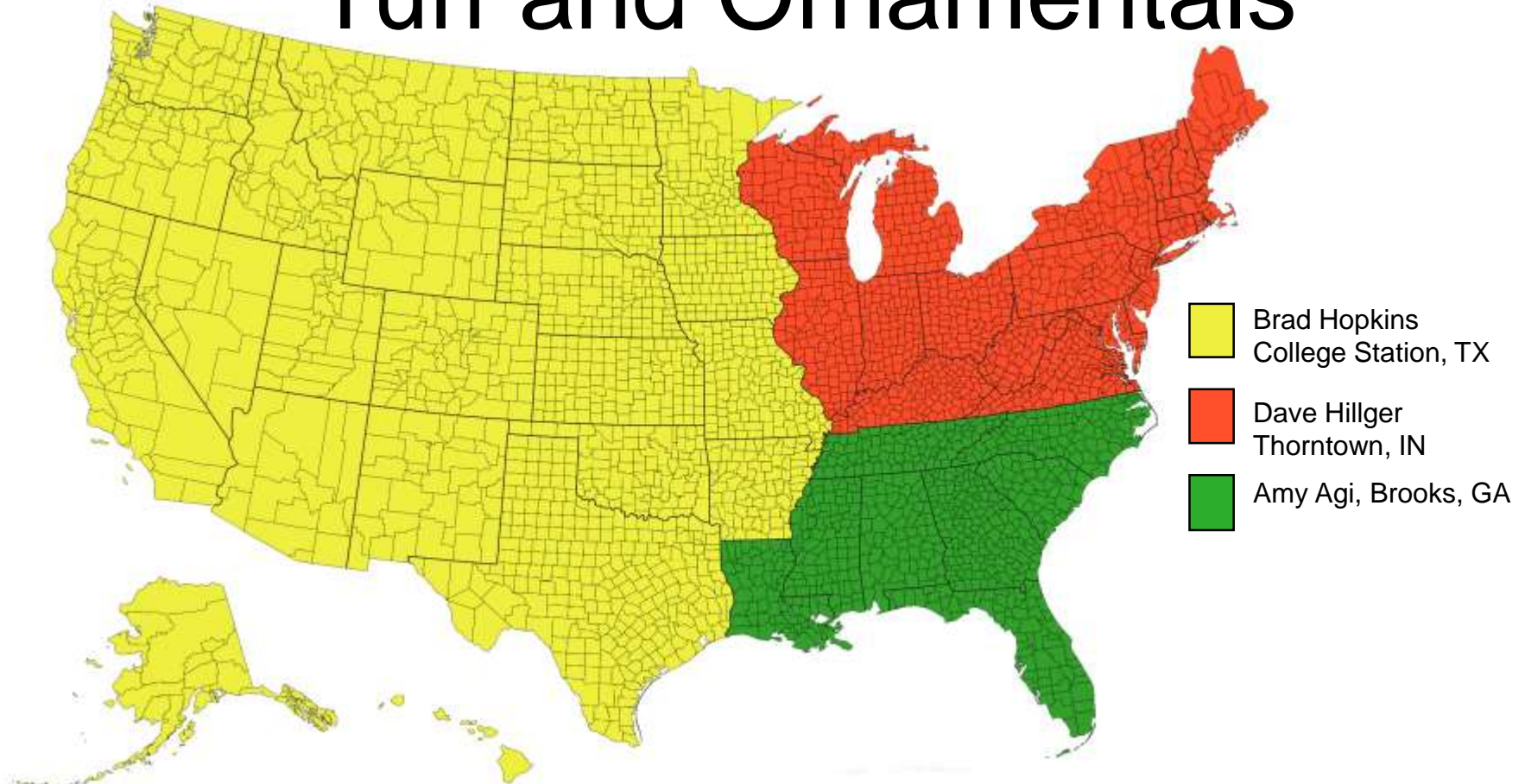


Corteva Agriscience™

Agriculture Division of DowDuPont



Turf and Ornamentals



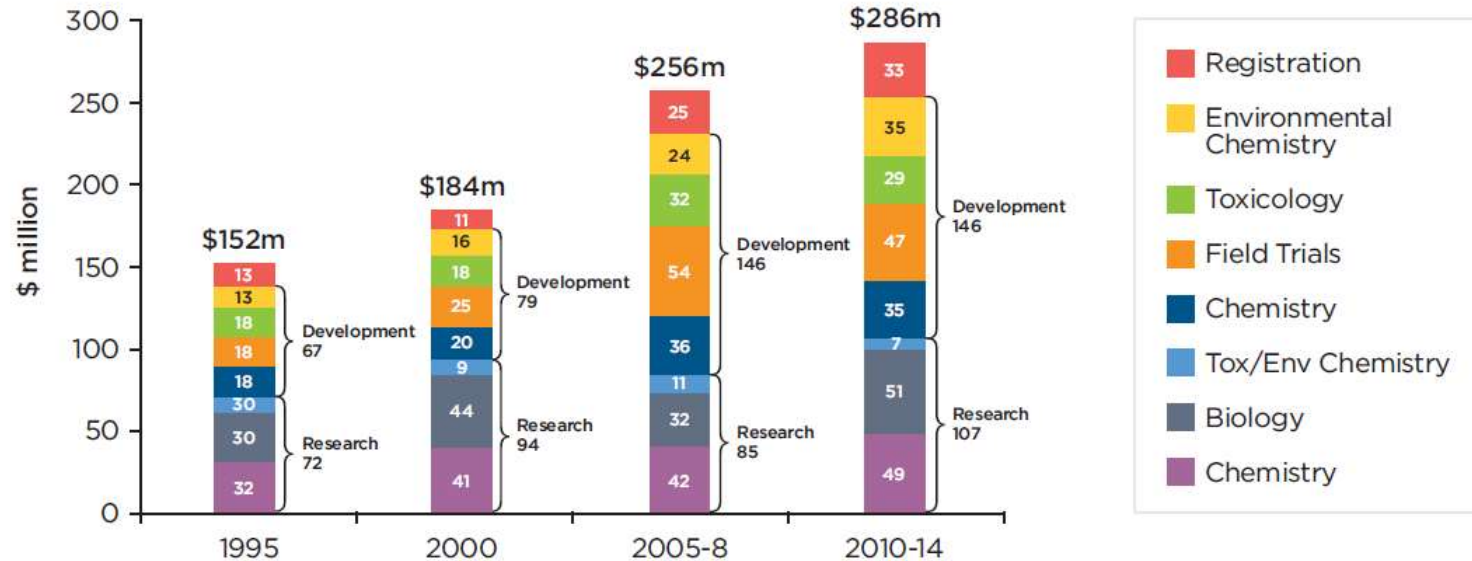
Challenges and Opportunities

- New crop protection products are very expensive to discover, develop and register
 - Sales of \$100 million or more may be required to justify investment; T&O sales of products rarely exceed \$15 Million per year
- Major crops markets most often considered for new products
 - soybeans, maize, rice, fruits and vegetables, cotton, potatoes, wheat

Turf and Ornamental Product Development

- Uses of an active ingredient in a T&O product will not be considered if the use could negatively impact or jeopardize the use in the major crops markets
 - Risk Cup Issues
 - Imprelis
 - Clopyralid
 - GMO Turf
- Projected lifespan of new product is 20 years or more in order to justify the investment.

Discovery and development costs of a new crop protection product



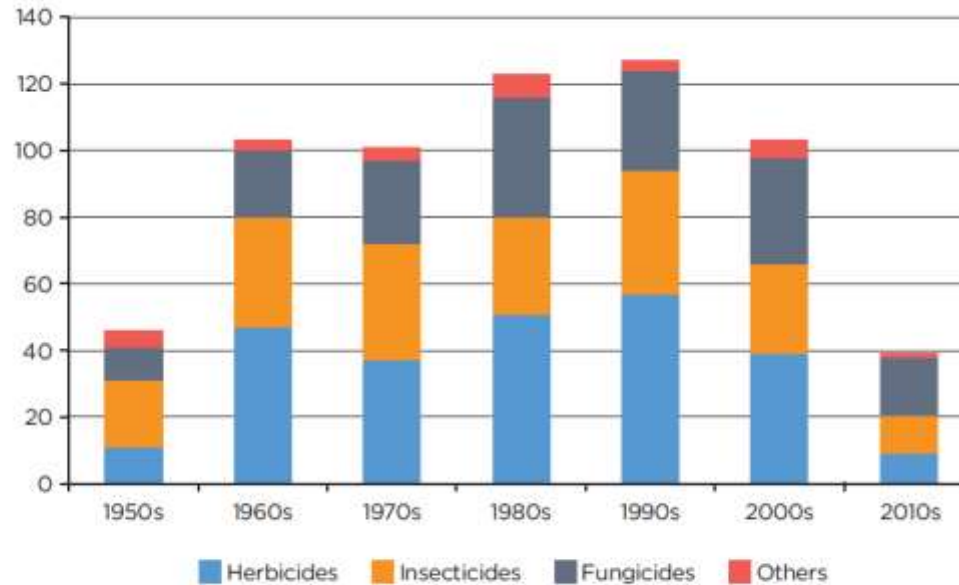
Source: Phillips McDougall, 2016

Time to develop a new crop protection product

	1995	2000	2005-8	2010-15
Number of years between the first synthesis and first sale of product	8.3	9.1	9.8	11.3

Source: Phillips McDougall, 2016

Number of new active ingredients introduced per decade: 1950's to present day

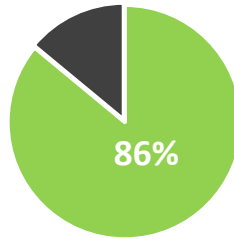


Source: Phillips McDougall Database

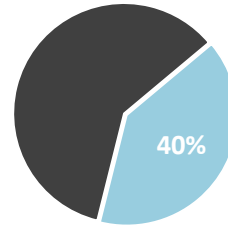
Agriculture Industry faces Significant Resistance Issues

% Industry Sales of Active Ingredients with Evidence of Resistance

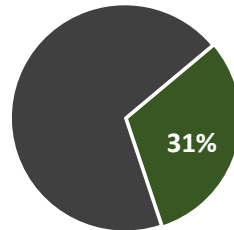
Herbicides



Insecticides



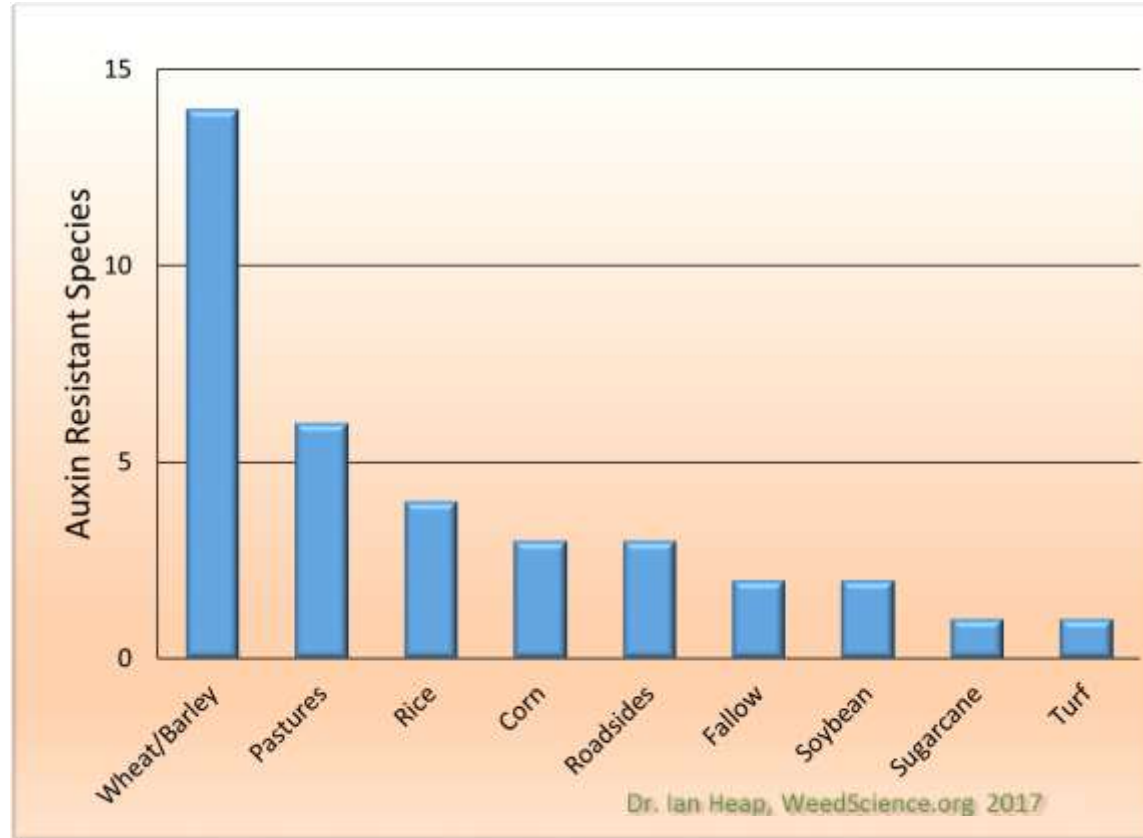
Fungicides



Source:- Dow AgroSciences estimates

Weed Resistance in Turf and Ornamentals

- Selection pressure for herbicide-resistant biotypes in lawn and landscape tends to be less due to the occurrence of non-treated areas in close proximity that provide a “refuge” of non-resistant biotypes
- Greater risk in golf, nurseries and areas where there is greater selection pressure due to frequency and rate of application on annual grasses such as *Poa annua*, crabgrass and goosegrass.





Dow AgroSciences

1. What's Old is New Again

- selective herbicide
- preemerg & early postemerg
- controls grasses and broadleaves
- warm season turf

EPA Reg 1979, recent label in CA 2013

Mitotic inhibitor- inhibits plant cell division
preventing root development



®Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

For use on turf grown for sod, nonresidential sites, golf courses, industrial and office building sites, stadium fields or professional athletic fields; woody ornamentals, ornamental nursery stock, and Christmas trees

Group	3	HERBICIDE
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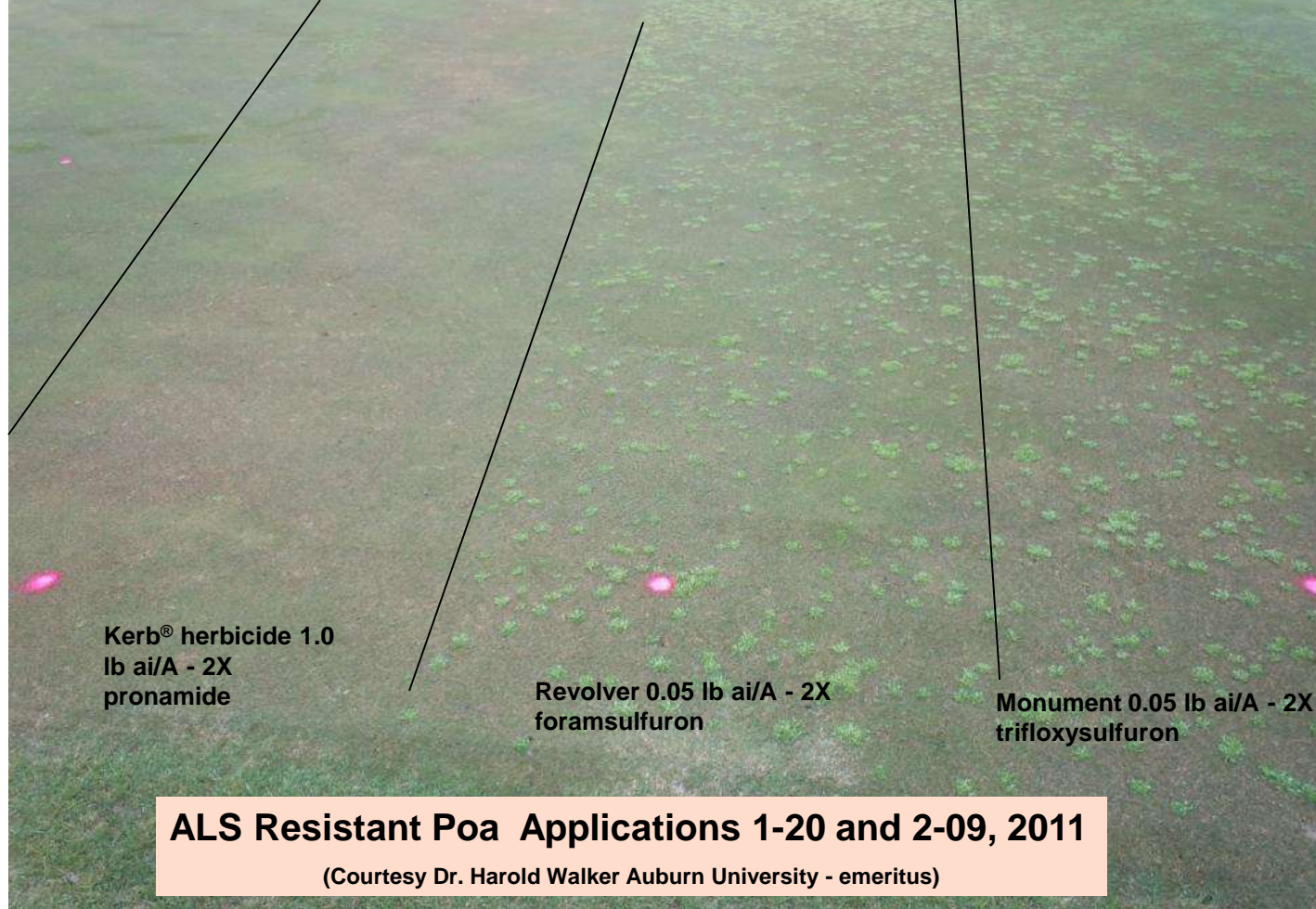
Active Ingredient:
pronamide: 3,5-dichloro-N-(1,1-dimethyl-2-propynyl) benzamide 35.6%
Other Ingredients..... 64.4%
Total 100.0%

Contains 3.3 lbs of active ingredient per gallon.

Pronamide activity

Closer inspection reveals the prevention of root development





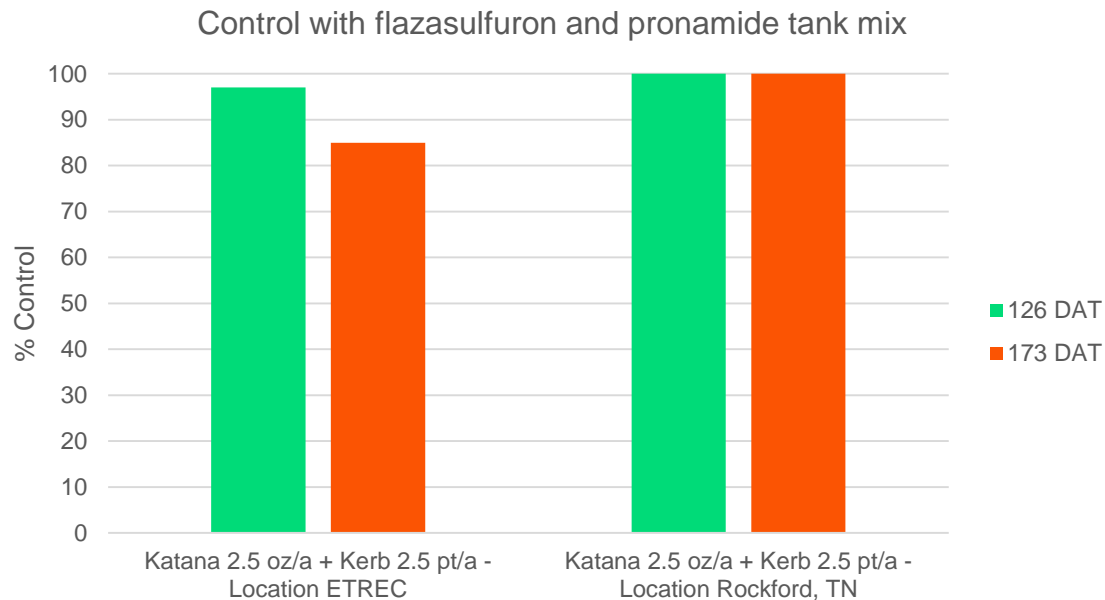
Jun 22, 2016

Pronamide (Kerb SC T&O) 3.5pt
+ Dithiopyr (Dimension 2EW) 1qt
Applied Nov 20, 2015

Revolver Applied Feb. 2016

- Pronamide is an effective poa control tool in C4 turfgrass (i.e. curative)
- Include preemergence herbicide in overall strategy (i.e preventative)
- Manage healthy dense turf
- *What's "old" is new*

2017 *Poa annua* Trial Work





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2. Use of Established and Proven Chemistries in other Markets

NativeKlean™

HERBICIDE

Relzar™

Arylex™ active

SPECIALTY HERBICIDE



NativeKlean™

HERBICIDE

Specially designed herbicide for native and naturalized areas,
providing a low maintenance solution
for consistent control of broadleaf weeds.

®™Trademark of Dow AgroSciences, DuPont or Pioneer and their affiliated companies or respective owners. Always read and follow label directions.

HERBICIDE

- Consistent, broad spectrum control of more than 100 broadleaf weeds in native areas
- Long residual control & application flexibility in native areas
- Enables efficient use of limited resources in native areas

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NOT LABELED FOR USE ON
golf course fairways, roughs, green
or tees; lawns; managed turf or
other similar areas



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Arylex™ Active Enhances Existing Herbicide Portfolio



Treated with
Arylex™ Active

- New broadleaf weed herbicide for utility in multiple crops (wheat, barley, burn down and turfgrass)
- Innovative resistance management tool from a novel area of chemistry
- Superior performance against most hard-to-control weeds
- Weed control not as temperature dependent

Relzar™

Arylex™ active

SPECIALTY HERBICIDE

*Subject to regulatory approvals and other assumptions; Represents first year of commercial sales in a significant market through the year when sales are established in markets which represent 80% of the new product value. **Trademarks of Dow AgroSciences, DuPont or Pioneer, and their affiliated companies or their respective owners. Arylex is a registered active ingredient

SIMPLIFIED WEED CONTROL.

Relzar™

Arylex™ active

SPECIALTY HERBICIDE

Relzar™ specialty herbicide provides powerful postemergence weed control on warm- and cool-season grasses with one low use rate.



TURFGRASS SAFETY

Apply to warm- and cool-season grasses with no temperature restrictions



RAINFAST

After 1 hour



ONE LOW USE RATE

For all labeled turf types and weeds



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KEY WEEDS CONTROLLED & TURF SPECIES

Relzar™

Arylex™ active

SPECIALTY HERBICIDE



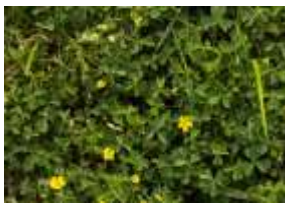
Chickweed



Doveweed



Henbit



Oxalis



Dollarweed



Plantain

TURF SPECIES

WARM-SEASON

Bermudagrass

Kikuyugrass

St. Augustinegrass

Buffalograss

Centipedegrass

Seashore paspalum

Zoysiagrass

Bahiagrass

COOL-SEASON

Bentgrass

Fescue (tall & fine)

Bluegrass

Ryegrass

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3. Reformulating Effective Actives to Minimize Negative Characteristics and Preserve the Positive

GameOnTM

ArylexTM active

SPECIALTY HERBICIDE

FAST ACTING. COMPLETE CONTROL.

GameOn™

Arylex™ active

SPECIALTY HERBICIDE

GameOn™ specialty herbicide combines the power of new Arylex™ active and 2,4-D choline with proven fluroxypyr.



NEW CHEMISTRY

Arylex active is a new active ingredient



TESTED

Extensively tested around trees



COMPLETE CONTROL

Systemic control of 100+ broadleaf weeds



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GAMEON™ SPECIALTY HERBICIDE AT A GLANCE

GameOn™

Arylex™ active

SPECIALTY HERBICIDE

ACTIVE INGREDIENTS

Arylex active, 2,4-D choline, Fluroxypyr

RECOMMENDED RATE

3.5 pts/A

SIGNAL WORD

Warning

LOW VOLATILITY

Mitigates off-target concerns

RAINFAST

Two hours

LOW ODOR

New 2,4-D choline

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KEY WEEDS CONTROLLED & TURF SPECIES

GameOn™

Arylex™ active

SPECIALTY HERBICIDE



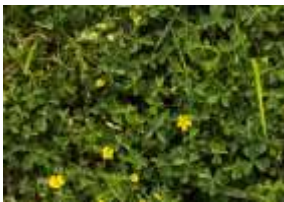
Dandelion



Clover



Henbit



Oxalis



Ground Ivy



Plantain

TURF SPECIES

COOL-SEASON

Bentgrass*
Fescue (tall & fine)

Bluegrass
Ryegrass

WARM-SEASON

Bermudagrass*
Zoysiagrass

* ½ inch mowing height or higher

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4. Combination Approach

CrewTM

SPECIALTY HERBICIDE

Dependable and versatile pre-emergent granular solution for your turf & landscape bed needs



- Broad spectrum pre-emergent control of more than 60 weeds
 - Controls both grassy and broadleaf weeds such as crabgrass, dandelion, chickweed, spurge etc.
- Combines the power and proven safety of two well established actives into one easy to use granular herbicide.
- Long lasting consistent results up to 5 months

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Easy-to-use

- Low odor formulation
- Dust-free granule reduces exposure
- Non-staining
 - Reduces customer complaints

Standard granule



Verge™ granule technology



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To Summarize:

1. What's old is new again new uses for older chemistries;
2. Use of established and proven chemistries in other markets;
3. Reformulating effective actives to minimize negative characteristics and preserve the positive;
4. Combination of all of these approaches.

In the end...

T&O Manufacturers desire to preserve the use of products in their portfolios

- Product stewardship
- Exploring combinations of active ingredients with different modes of action and discovery of new active ingredients
- Work in partnership with University cooperators to understand and address pest control/resistance issues as they occur

Thank You