

A photograph of a field with yellow, red, and purple flowers under a blue sky. The text "Aminopyralid/Milestone Review" is overlaid on the image.

# Aminopyralid/Milestone Review

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Dow AgroSciences, LLC





# Agenda

- Background information on aminopyralid
- Grass tolerance
- Key weeds controlled
  - Results on selected weed species
- Toxicology and Environmental characteristics
- Future research



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invasive weed  
control.

# Aminopyralid

- Active Ingredient = aminopyralid
  - Auxinic mode of action
  - Systemic, phloem and xylem mobile
  - Absorbed by leaves and roots
- Federal EPA registration in August 2005
  - Federally registered under EPA's Reduced Risk Pesticide program
  - Registration in 48 states, more are pending including California (due in early October 2006)
  - Part of a NAFTA submission to Canada and Mexico



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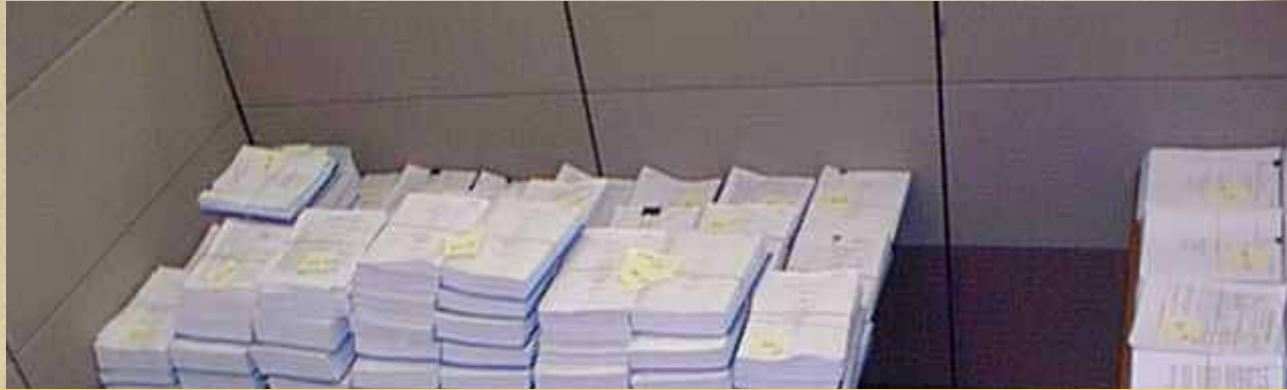
# EPA Federal Registration Data Requirements



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# EPA Federal Registration Data Requirements



Aminopyralid was the first full electronic submission to EPA



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# Aminopyralid

- Excellent control of many broadleaf weeds including many noxious and invasive plants
- Residual control of new seedlings
- Excellent tolerance by a wide range of established warm and cool season forage grasses
- No groundwater advisory
- Use up to the waters edge
- Not a federally Restricted Use herbicide




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# Products

- Aminopyralid alone
  - aminopyralid, 2 lbs ae/gal
  - Rate range = 3 to 7 fl oz/acre
  - 0.05 – 0.1 lb ae/acre



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**Milestone<sup>TM</sup>**

**Specialty Herbicide**

<sup>TM</sup>Trademark of Dow AgroSciences LLC



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# Aminopyralid is Effective in Controlling Key Noxious/Invasive Weeds



Canada thistle



Spotted knapweed



Tropical soda apple

Russian knapweed



Yellow starthistle

Musk and plumeless thistles



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# Invasive Plants Controlled by Aminopyralid\*

Common name	Scientific name
cinquefoil, sulfur	<i>Potentilla recta</i>
daisy, oxeye	<i>Chrysanthemum leucanthemum</i>
hawkweed, orange	<i>Hieracium aurantiacum</i>
hawkweed, yellow	<i>Hieracium pratense</i>
knapweed, diffuse	<i>Centaurea diffusa</i>
knapweed, Russian	<i>Acroptilon repens</i>
knapweed, spotted	<i>Centaurea maculosa</i>
starthistle, yellow	<i>Centaurea solstitialis</i>
thistle, Canada	<i>Cirsium arvense</i>
thistle, musk	<i>Carduus nutans</i>
thistle, plumeless	<i>Carduus acanthoides</i>
tropical soda apple	<i>Solanum viarum</i>



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\* 3 to 7 fl oz/ac

# Weeds Not Controlled by Foliar Applications of Aminopyralid

- leafy spurge
- kochia
- Russian thistle
- dogfennel (southern)
- wild carrot
- plaintain
- goldenrod
- vervain
- rubber rabbitbrush
- broom snakeweed
- Dalmatian toadflax
- yellow toadflax
- poison hemlock
- buckbrush/snowberry
- houndstongue
- common bugloss
- viper's bugloss
- hoary cress (whitetop)
- bur chervil

Tank mixes may help control these weeds

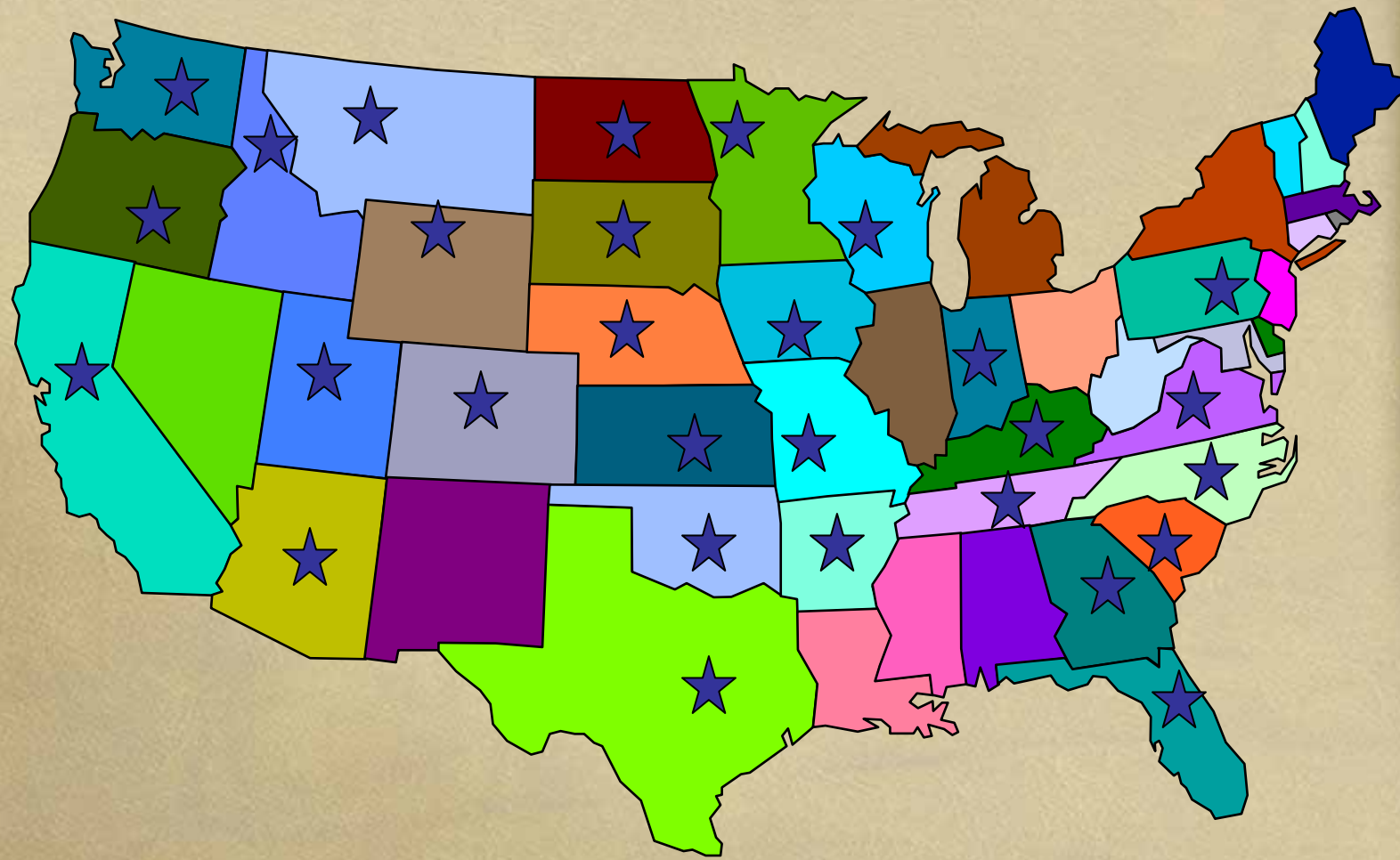


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# National Field Efficacy Testing Program 1999-2005



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# Aminopyralid: Grass Tolerance

- Grass tolerance was evaluated in more than 60 field trials in 1999-2005
- Over 20 different range and forage grass species were tested
  - Warm and cool season grasses
- Aminopyralid showed the same or better safety when compared to herbicide standards



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Canada thistle shoots and roots  
Colorado State University





# Canada Thistle Control with Milestone Applications at Prebud - 1 Year After Treatment



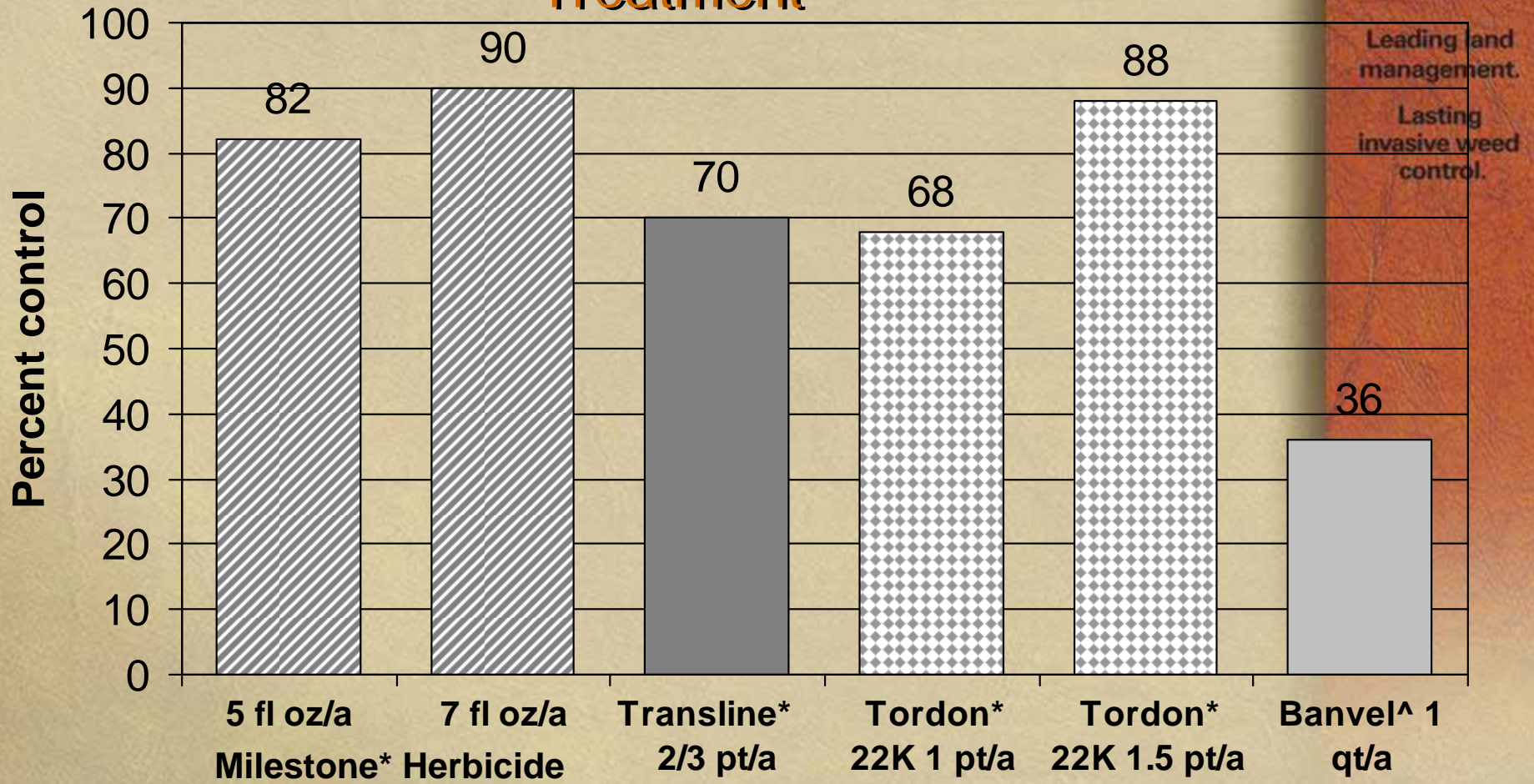
**Untreated**

**Milestone  
5 fl oz/a**





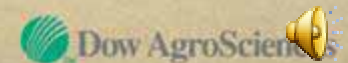
# Control of Canada Thistle with Milestone Pre-bud Applications Evaluated 1 Year After Treatment



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Average of 24 trials (CO, MN, MT, ND, SD, NE, OR, VA, SD, OR, WA, and WY)

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# Canada Thistle Control with Milestone Application in fall - 1 Year After Treatment



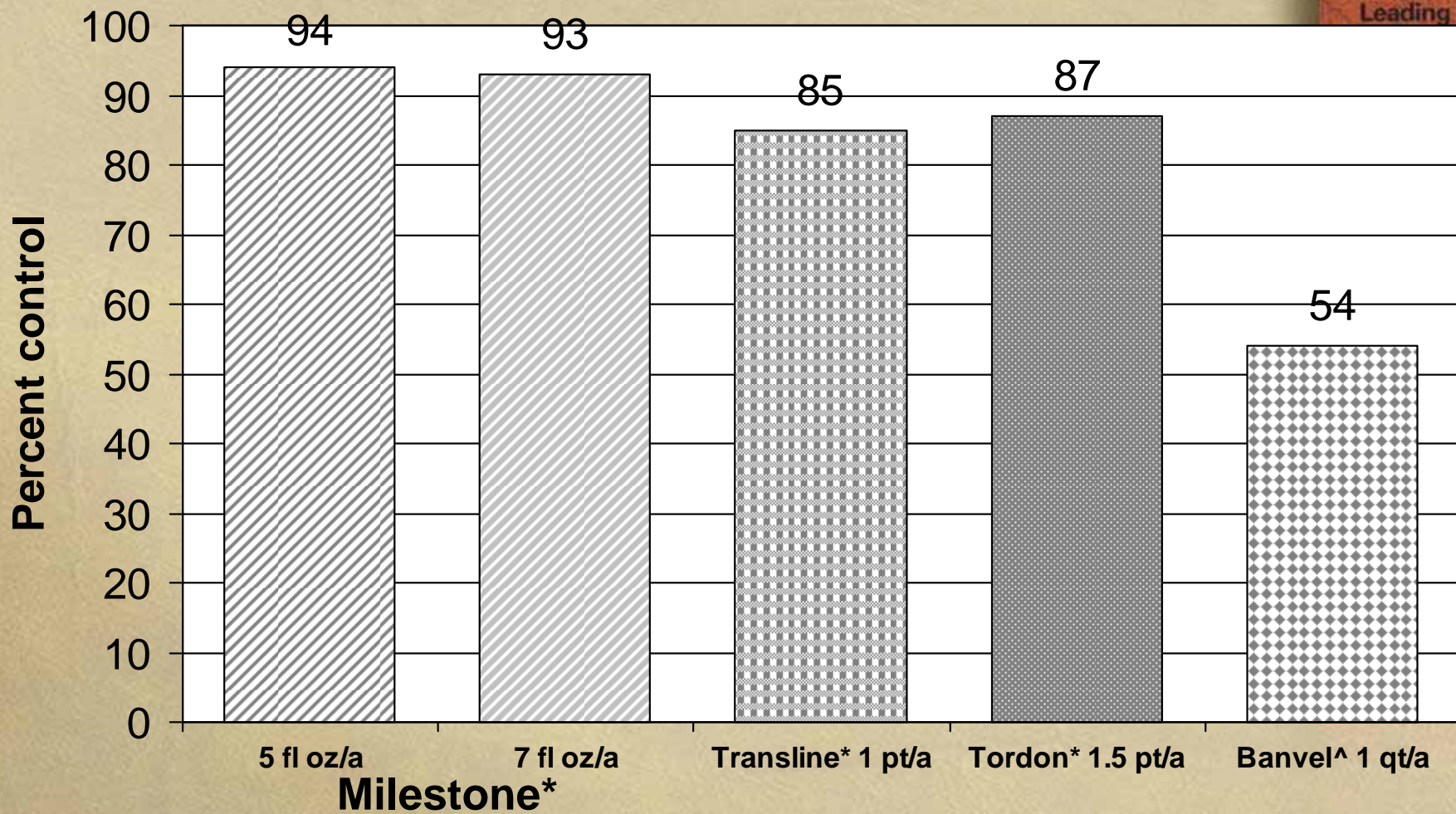
**Milestone 7 fl oz/A**

**Non-treated**



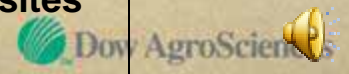


# Control of Canada Thistle with Fall Applications of Milestone Compared to Standards



Evaluations at 1 year after treatment. Average of 15 sites  
VA, ND (2), SD, NE, WY, CO, and WA

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**Yellow starthistle treated at  
rosette, 1 year after treatment**

**Untreated**

**Milestone at  
3 fl oz/A**





# Spotted Knapweed - 1 year after treatment

**Milestone 5 fl oz/A**

**Untreated**

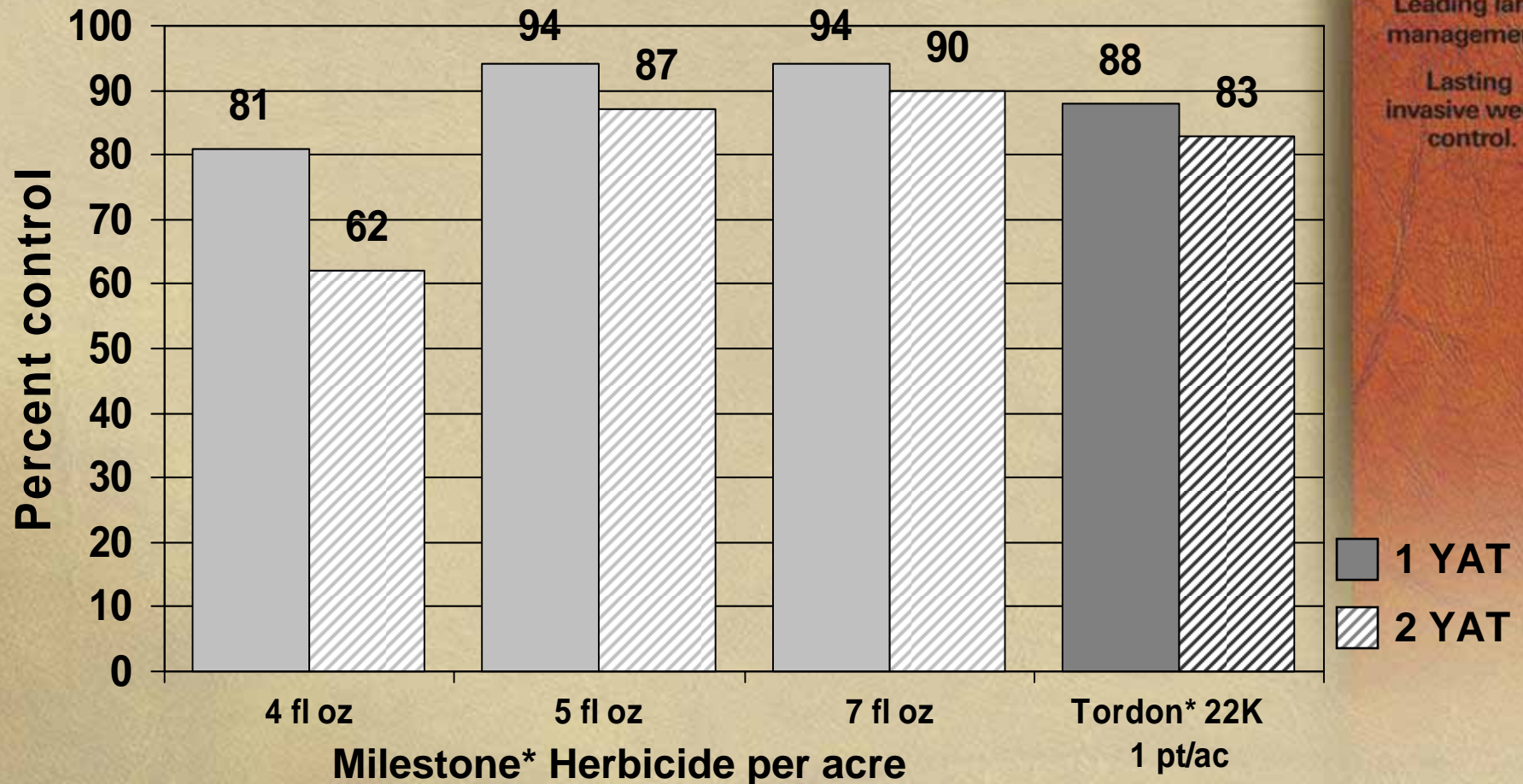




# Spotted Knapweed Control with Milestone Rosette/Bolting Growth Stage Application



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Evaluations average of 5 locations: Montana (3), Idaho (1), Washington (1); 2 YAT, Montana (1)

No significant difference LSD ( P=0.05)

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# Diffuse Knapweed Control (aerial trial) at 1 Year After Treatment

**Untreated**

**Milestone at  
7 fl oz/A**





# Toxicology, Ecotoxicology, and Environmental Fate

Over 120 tests  
are completed  
for EPA  
registration  
package



Both laboratory and field  
studies are conducted  
8-10 years and \$80 million



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# Acute Toxicology Profile

No acute hazard

“CAUTION” signal word

\* least toxic category

<u>Study</u>	<u>Milestone</u>
Acute Oral	LD <sub>50</sub> >5000 mg/kg
Acute Dermal	LD <sub>50</sub> >5000 mg/kg
Acute Inhalation	LC <sub>50</sub> >5.79 mg/L
Eye Irritation	Mild Irritant
Dermal Irritation	Slight Irritant
Dermal Sensitization	Negative



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# Mammalian Chronic Toxicity

- Based on laboratory studies, no significant adverse effects, including:
  - No reproductive or endocrine effects
  - No developmental effects
  - No genotoxicity
  - No neurotoxicity
  - No carcinogenicity



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# Human and Mammalian Health and Safety

- Aminopyralid does not bioaccumulate or build up in animal or plant tissue.
  - Animals high on the food chain (humans, eagles, wolves) are not expected to acquire concentrated doses of this chemical by feeding on contaminated plants or animals.
- Aminopyralid is water soluble and is excreted in urine relatively rapidly.
- There is a tolerance established by EPA in meat, milk and animal by-products



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# Ecotoxicology

## AMINOPYRALID IS PRACTICALLY NON-TOXIC\* TO

Birds - bobwhite quail, mallard ducks

Fish - rainbow trout, bluegill sunfish,  
sheepshead minnow, fathead  
minnow



### Aquatic invertebrates

*Daphnia magna*

mysid shrimp

eastern oyster (slight toxicity)

midge (*Chironomus riparius*)

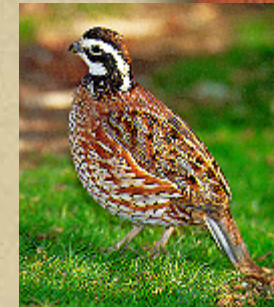
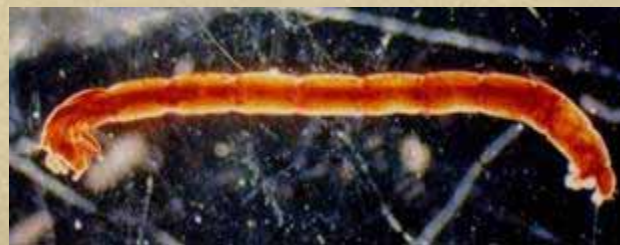


### Terrestrial invertebrates

honeybees and earthworms

### Amphibians

northern Leopard frog



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\* Practically non-toxic is EPA's least toxic category 



# Ecotoxicology

## AMINOPYRALID IS SLIGHTLY TOXIC TO

### Algae

green and blue-green  
freshwater algae,  
freshwater and saltwater  
diatoms



### Aquatic vascular plants

*Lemna gibba*

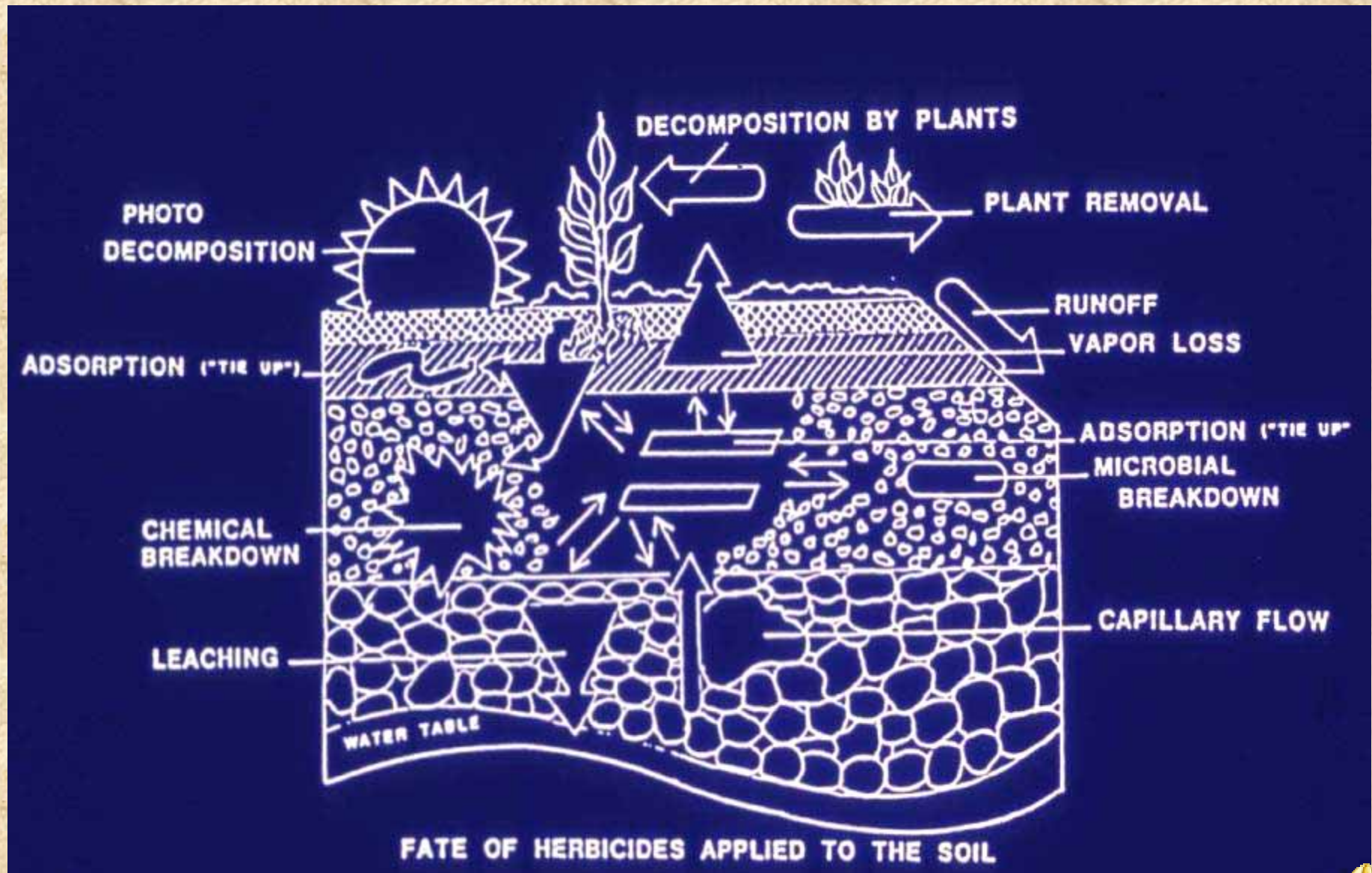


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# Fate of Herbicide Application





# Environmental Fate Summary

## Soil

- Major degradation in soil through microbial activity
- **NO** significant metabolites (only CO<sub>2</sub> and naturally occurring organic acids)
- Moderate degradation rates in soil
  - Soil half life, average 35 days
- Mobility
  - Low leaching potential
- Low vapor pressure reduces volatility
  - “essentially non-volatile”



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# Milestone Levels In Soil

## Percent remaining 22 and 90 DAA



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### Manitoba (7 fl oz)

22 DAA    90 DAA

6" 64%	14%
12" 14%	2.4%
18" (*T)	↓ N.D.
N.D.	
N.D.	
N.D.	

### California (7 fl oz)

22 DAA    90 DAA

6" 49%	0.9 %
12" 14%	↓ N.D.
18" (*T)	
24" N.D.	
30" (*T)	
N.D.	

Precip    15 inches

14 inches

\* Less than quantifiable levels (between LOD and LOQ)



# Environmental Fate Summary

## Water

- Aquatic degradation
  - Degraded by sunlight within 15 hours in surface water
- Low groundwater contamination potential
  - Low application rate and moderate field degradation
- No groundwater advisory on label
- Can apply in seasonally dry wetlands
  - Can spray up to the waters edge
  - Can spray in sub-irrigated meadows



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# Milestone™

Registered under the EPA's Reduced Risk Pesticide initiative

- ❖ **Excellent environmental profile for use in integrated invasive plant management programs in wildlands and other natural resource areas:**
  - ❖ **Least toxic category for humans (CAUTION)**
  - ❖ **“Practically non-toxic” to non-target organisms**
  - ❖ **Not a restricted use product**
  - ❖ **No groundwater statement**
  - ❖ **Can be used in riparian areas**
  - ❖ **Apply to seasonally dry wetlands**
  - ❖ **Apply up to the waters edge**





Herbicides are just  
one tool in the  
toolbox to manage  
invasive plants



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# Future Research Focus

- Efficacy/control of more plants
  - EX. Trials with Drs. Tim Miller and Kim Patten, WSU, on invasive knotweeds
- Understanding more about interaction with non-target plants
  - Research begun in 2005 with Dr. Joe DiTomaso in CA and Dr. Peter Rice in MT on native and non-target plants
- Increasing knowledge on the fit in restoration programs
  - How soon after use of Milestone can grasses or other plants be planted?
    - Regional trials with Dr. Scott Nissen, CO, Dr. Stephen Enloe, WY, and Dr. Bob Wilson, NE



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[www.milestoneherbicide.com](http://www.milestoneherbicide.com)

[www.dowagro.com](http://www.dowagro.com)

7/13/2005



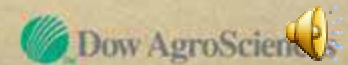


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Thank you

Questions?





# Herbicide Mobility Factors



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Herbicide	Solubility ppm	Soil Sorption Koc (ml/g)	Half Life (mean days)	Max Rate lb ae/acre
Aminopyralid	2480	10.8	34.5	0.1
2,4-D	311	41	10	2
Dicamba	4500	13.4	4.4	1
Picloram	560	12.41	90	0.5
Clopyralid	1000	4.6	10.75	0.5
Metsulfuron methyl	2790	90	169 (fall) 64 ( spring)	0.15





# What is the run off potential of Milestone?

- Milestone has a Low Risk of run off in surface water compared to the market standards for R&P and IVM.
- Run off impact is mitigated by Milestones low use rate and rapid photolysis in water.
- Modeling scenarios using EPA´s surface water assessment tools predict Milestone will have low run off potential with predicted environmental concentrations <10 ppb.



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# Run-Off Potential of Aminopyralid

- No real-world data has been generated for the runoff or drift of aminopyralid, although the low application rates in the field should lower the likelihood of adverse impact.
- USEPA has developed a method to screen compounds for their potential to reach surface water by employing the *GENeric Estimated Environmental Concentration* (GENEEC) model.
- GENEEC takes inputs of chemical fate in soil and water, physical properties, and application methodology to generate a Generic Expected Environmental Concentration (GEEC) in water.



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# Transport Potential of Milestone to Surface Water

- Model is used to determine run-off potential of herbicides. Factors include:
  - chemical fate in soil and water,
  - physical properties,
  - application method – ground or air (DRIFT)
- Develops: Generic Expected Environmental Concentration (GEEC) in water.



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# Run-Off Potential Modeling




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Active ingredient	Scenario	Rate (lb/A)	Peak GEEC (ppb)
Aminopyralid	Milestone (Ground) Aerial	0.107 (7 fl oz)	5.95 6.18
2,4-D	R&P (various formulations)	2	88.6
Dicamba	Clarity (ground)	2	103.8
Picloram	Grazon P+D	0.54	29.9
	Tordon K/Tordon 22K	1	55.4
Clopyralid	Transline (ground)	0.5	27.2
Metsulfuron-methyl	Escort (ground)	0.15	7.7

# EPA Ecotoxicology Acute Toxicity Categories

(per U.S. EPA, Hazard Evaluation Division, Office of Pesticide Programs)

On an Acute Basis the Material is:

Best 

CATEGORY	LC <sub>50</sub> (ppm)
PRACTICALLY NON-TOXIC	> 100
SLIGHTLY TOXIC	10 - 100
MODERATELY TOXIC	1.0 - 10
HIGHLY TOXIC	0.1 - 1.0
VERY HIGHLY TOXIC	< 0.1



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# Herbicide Mobility Factors



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Herbicide	Solubility (ppm)	(Koc)	Half life (avg)
Metsulfuron (Escort)	1750-9500	30-55	7-42 (30)
Picloram (Tordon 22K)	430	13-70	20-300 (90)
Aminopyralid (Milestone)	2480	11	9-54 (34)
2,4-D	311	41	7-30 (10)
Imazapic (Plateau)	2200	260	31-410 (120)
Glyphosate (Roundup)	1570	24000	<25-90 (47)

## Other Weedy Plants Controlled by Aminopyralid\*

Common name	Scientific name
absinth wormwood	<i>Artemisia absinthium</i>
amaranth, spiny	<i>Amaranthus spinosus</i>
broomweed, annual	<i>Gutierrezia sarothrae</i>
camphorweed	<i>Heterotheca latifolia</i>
croton, woolly	<i>Croton capitatus</i>
cudweed	<i>Gnaphalium spp.</i>
dock, curly	<i>Rumex crispus</i>
horsenettle, Carolina	<i>Solanum carolinense</i>
horseweed/marestail	<i>Conyza canadensis</i>
ironweeds	<i>Veronia sp.</i>
lettuce, prickly	<i>Lactuca serriola</i>
ragweeds	<i>Ambrosia sp.</i>
sneezeweed, bitter	<i>Helenium amarum</i>
sowthistle	<i>Sonchus sp.</i>

\*4 to 7 fl oz/ac



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# Field Dissipation Results

Milestone applied at 7 fl oz/acre at test locations in U.S. and Canada

- Manitoba:

- Loam (2% OM; 33% sand )
- Avg temp: 36
- Irrigation +rainfall: 15" total (~11" for 90 DAA)
- Applied bareground ←

- California (Fresno)

- Sandy loam (0.9% OM; 54% sand)
- Avg temp: 64
- Irrigation + rainfall: 2.77" (22 days); 11.4" (90 days)
- Applied bareground ←

**Worst Case Situations**



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