Weed Management Options "New & Old" for Range & Pasture and Invasive Weed Programs

South Coast Workshop
Santa Maria, CA
Feb 20th, 2018

Rick Miller

Dow AgroSciences

916-212-8598

rmiller@dow.com

Introductions

Rick has been a California PCA since 1986;
30+ years in the industry;
Bachelor's (double major) in Environmental Biology & Environmental Studies, UCSB, 1980
Master's in Entomology from Oregon State University, 1984
biosys, Inc 1985-1997
SePRO Corp. 1997-2005
Dow AgroSciences 2005 - present

RICK MILLER, PCA
Sr. Sales Representative-Specialty Products
Northern California/Reno Market
Folsom, CA

Dow AgroSciences

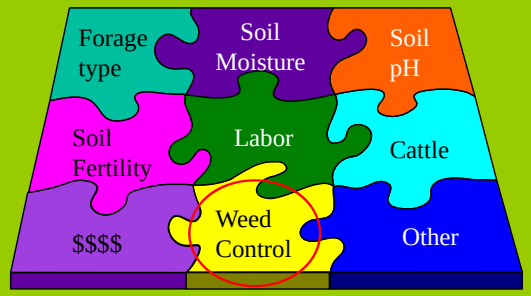
Beau Miller
Sacramento, CA
916-296-2811
BJMiller@dow.com
Territory
Northern CA, Bay Area, NV

Rick Miller
Folsom, CA
916-212-8598
RMiller@dow.com
Territory
Central & Southern CA

Vegetation Management
Markets Served

Utility
Irrigation Districts
Roadside
Range and Pasture
Invasive Species
Forestry
Aquatics

A Systems Approach to Range & Pasture Management



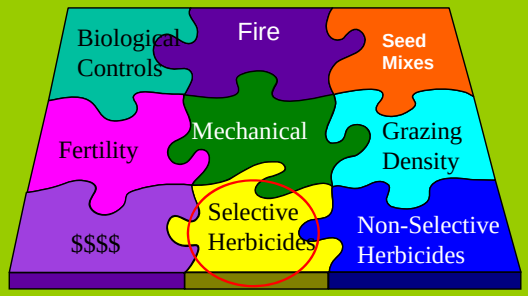
Dow AgroSciences has many options for weed management Pasture, Irrigated or Dry Land What is your objective?

Gorse on the Hearst Ranch

Dow AgroSciences Range & Pasture Portfolio

- **Accord XRT II**
- **Capstone**
- **Forefront**
- **Milestone**
- **Pathfinder II**
- **Redeem**
- **Remedy Ultra Ultra/Garlon 4 Ultra**
- **Spike 80DF**
- **Spike 20P**
- **Rodeo**
- **Transline**
- **Vista XRT**

A Systems Approach to Weed Management in Range & Pasture



Selective Herbicides

- Selective herbicides control the broadleaf weed and leave the grasses
- Use of a selective herbicide may be your most economical and effective tool for weed control
- Reduce competition – release desirable forage

Selective Herbicides

- More moisture & nutrients available for forage
- Increase grazing utilization
- Extend grazing production
- Increased yield = more pounds of BEEF = more profit

GPS Studies Show Cows Prefer Weed-Free Grass…

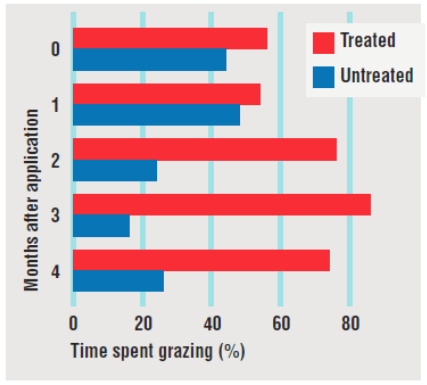
Surprise! Cows prefer clean grass!

University of Missouri Published Research

Given a choice, cattle grazed in the treated area 74% of the time

Missouri pasture

This is a satellite view of the pasture with all grazing points marked during the four months after spraying. Yellow dots mark grazing in the treated area; blue in the untreated area. Cattle grazed the treated part of the pasture 74 percent of the time.



Dr. Kevin Bradley, University of Missouri

Forage Yields in Actively Grazed Sites

- Treated sites yielded more forage even after grazing, compared to untreated sites
- Despite more grazing on treated sites, they maintained 430-570 lbs grass/acre
- Untreated sites lost forage volume over time, as weeds and uneven grazing pressure took their toll

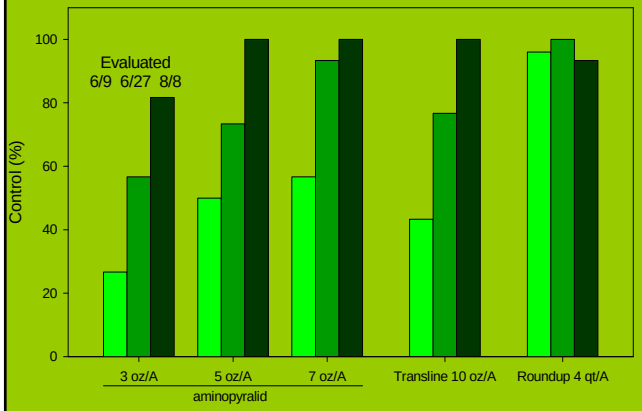
Why not just use Roundup to kill Your Weeds?

- World's largest herbicide
- Non-selective – kills grasses & broad leaves
- Opens up canopy for more broad leaf infestation
- No residual – spray today, gone tomorrow

Case Study: Artichoke thistle (Cynara cardunculus)

Joe DiTomaso and Guy Kyser

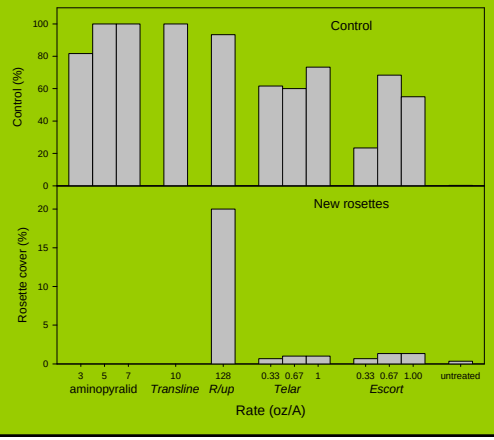
Artichoke thistle control, Solano County



Artichoke Thistle Control Options

Control of artichoke thistle with aminopyralid and other herbicides

Solano County
Treated 3/31/05
Evaluated 8/8/05



128 oz Glyphosate 4 MAA

Artichoke thistle control with Milestone – Grass Release

Dow AgroSciences Plant Growth Regulator Herbicides - Pyridines

Milestone® SPECIALTY HERBICIDE
Capstone® SPECIALTY HERBICIDE
Garlon® 4 Ultra SPECIALTY HERBICIDE
Transline® SPECIALTY HERBICIDE
Vista® XRT SPECIALTY HERBICIDE
Pathfinder® II SPECIALTY HERBICIDE
Garlon® 3A SPECIALTY HERBICIDE

Growth Regulator Herbicides Key Attributes

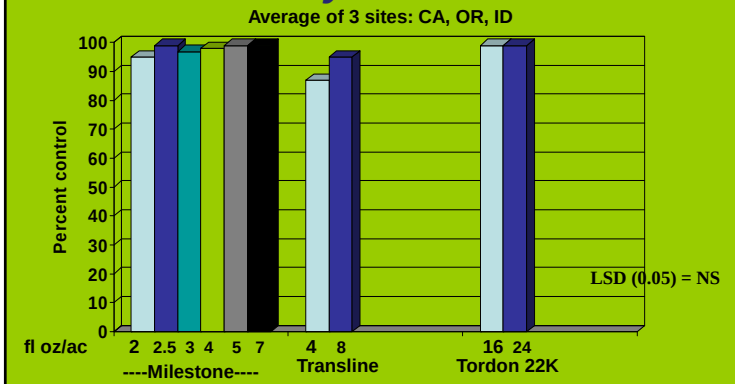
- Auxins are a group of plant hormones which promote cell elongation and stimulation depending on the cell location and concentration.
- Pyridine chemistry (growth regulator herbicide) is recognized by the plant as an auxin hormone signal.

Growth Regulator Herbicides Key Attributes

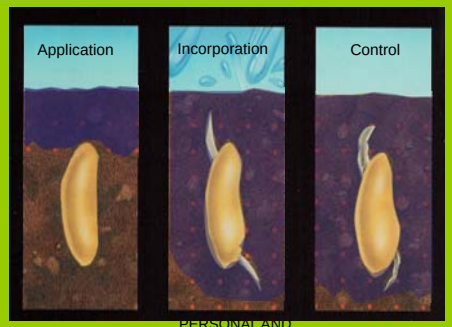
- Growth regulator herbicides affect plants by **accelerated growth via overload of auxin mimics**.
- Increases in pyridines can **crush the vascular system** of the plant, blocking it off from nutrients
- Net effect is **desiccation & death of the entire plant**

Yellow Starthistle Data

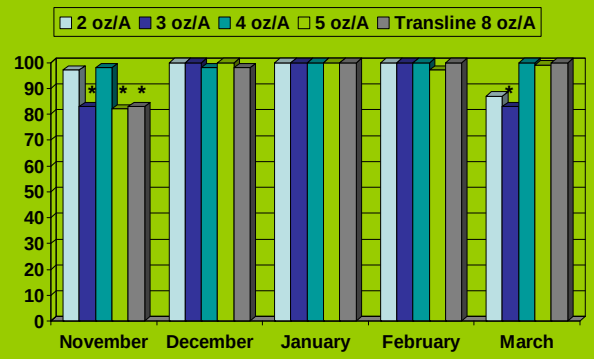
Milestone control of yellow starthistle at 1 year after treatment



Pre-emergent Herbicides Kill the Seedling
Very small plants require much less herbicide for control



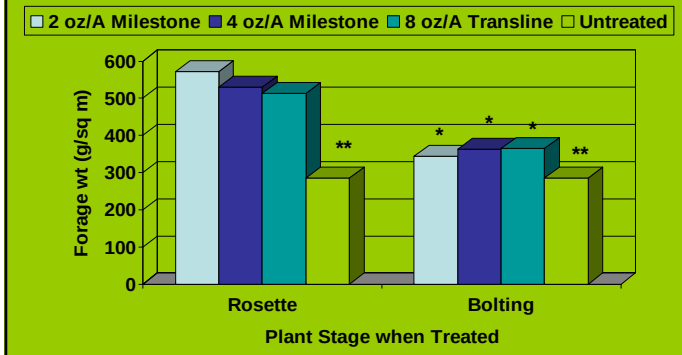
Effect of treatment timing on yellow starthistle control in Northern California



Treatments from Nov 2002 to March 2003, final evaluation in July 2003

*** LSD (P=0.05)**

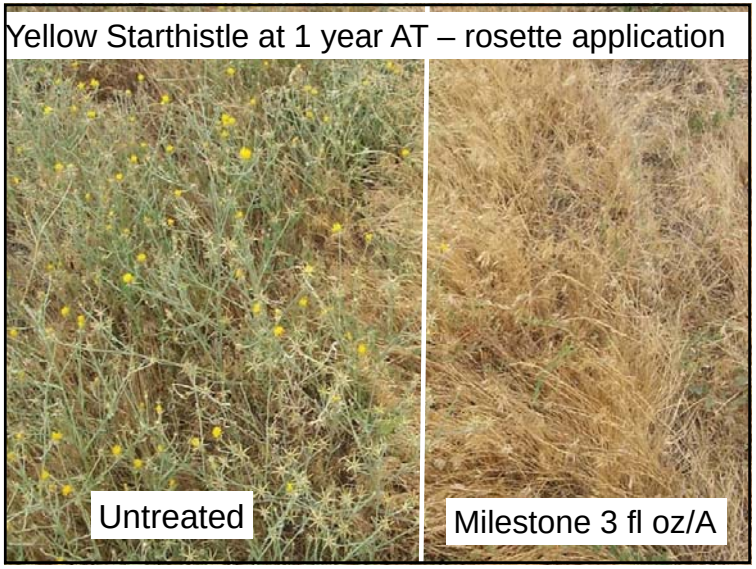
Effect of Milestone and Transline on grass forage in following year



Treated in 2003
Evaluated in spring 2004

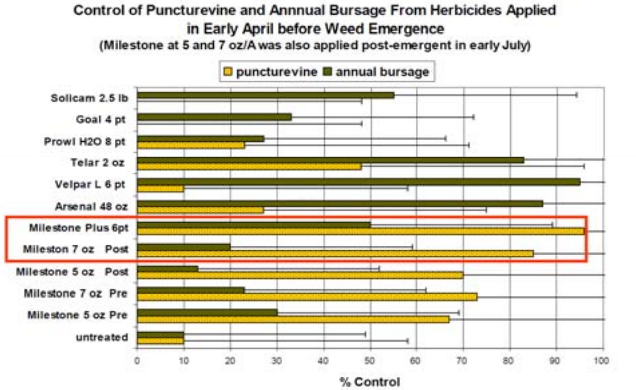
*** LSD (P=0.05)**

Yellow Starthistle at 1 year AT – rosette application



Milestone and Capstone, formerly known as "Milestone VM" and "Milestone VM Plus"

Performance on Puncturevine and Annual Bursage



Other Milestone VM rates 7 and 5 fl oz pre or 5 fl oz post were equally good

Aminopyralid: Milestone, Capstone

- **NOT** "restricted use" pesticides
- Registered as EPA **reduced risk pesticide**
- No grazing restrictions
- Has **pre and post emergent activity** for season long control of target broadleaf weeds
- Can be applied to "seasonally dry wetlands" and sprayed up to the waters edge

Aminopyralid Environmental and Ecotoxicology Summary

- Moderate degradation rates in soil
  - Soil half life = 34.5 days
- Mobility
  - Low potential for groundwater contamination
- Degradation by soil microbes
  - **NO** significant metabolites: mostly CO_2 and NH_3
- Aquatic degradation

- degraded by sunlight in water: Half life = 15 hours
- Low vapor pressure = essentially non-volatile

Milestone VM Ecotoxicology Review

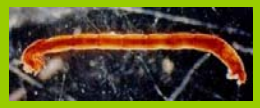
Based on laboratory studies Milestone is practically non-toxic to:

Birds - bobwhite quail
mallard ducks

Fish - rainbow trout
bluegill sunfish
sheepshead minnow
fathead minnow

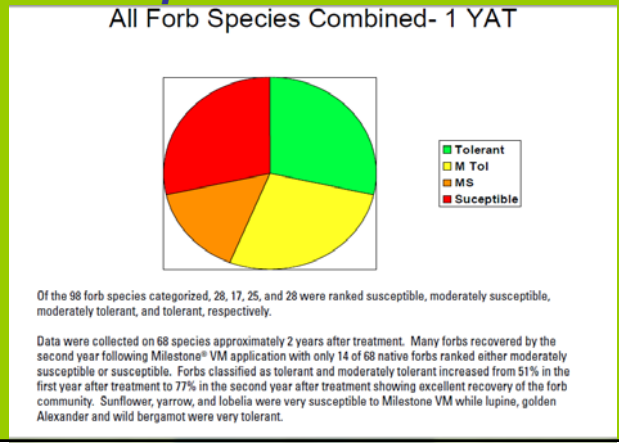
Milestone is Practically Non-toxic

Milestone Ecotoxicology Review

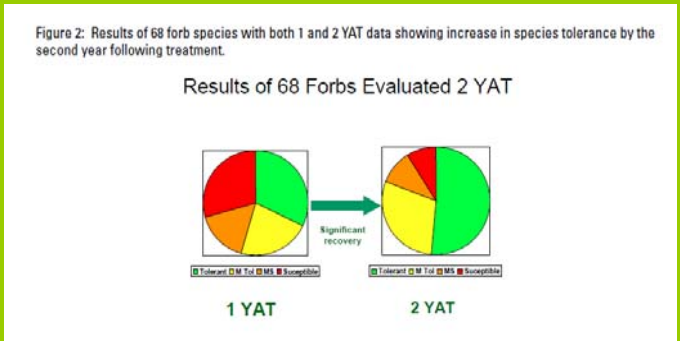


Aquatic invertebrates
Daphnia magna
mysid shrimp
eastern oyster (slight toxicity)
midge (*Chironomus riparius*)
Terrestrial invertebrates
honeybees and earthworms

Activity of Milestone on 98 species of forbs



Effect of Milestone on 68 Species of Forbs 1 & 2 years after treatment



29 plant families represented, with asters accounting for 35%

Milestone® Pre-Emergent & Post-Emergent Control

- Pre- and post-emergent activity on
  - 17 broadleaf families represented
  - 75 broadleaf weeds now labeled
- Pre-emergent activity 6+ months on
  - Russian thistle
  - Marestail
  - Fleabane
  - Mustards
- CAUTION signalword
- Reduced-risk Chemistry
- Very affordable per acre
  - Qts, 2.5s, and Continuum

Aminopyralid Stewardship

- Labeled for “non-crop” areas only
- ***Please stay out of grapes, vegetables, cotton, alfalfa, soybeans, ornamentals, fruit trees and other desirable trees***
- Always read the product label for specifics
  - Don’t mulch treated manure or hay
- Sprayer cleanout protocol

Milestone use under trees – some species are <u>not affected</u>

- Cottonwood
- Yellow poplar
- Ash
- Elm
- Cedars
- Oaks
- Black cherry
- Sweetgum
- Willow
- Maple
- Aspen
- Dogwood

Milestone: Do not use under leguminous or rosaceous trees

- Black locust
- Honey locust
- Other locust spp.
- Redbud
- Mimosa
- Caragena
- Rose
- Redwoods
- *Deodora* cedar

Phyto on Pepper Trees
Aerial Application on CA Ranch

Transline® Herbicide as Option Around Trees

- Clopyralid – selective control
- CAUTION signal word
- Non-volatile
- Safer around most crops
- Safer under desirable trees

Milestone Registered Use Sites

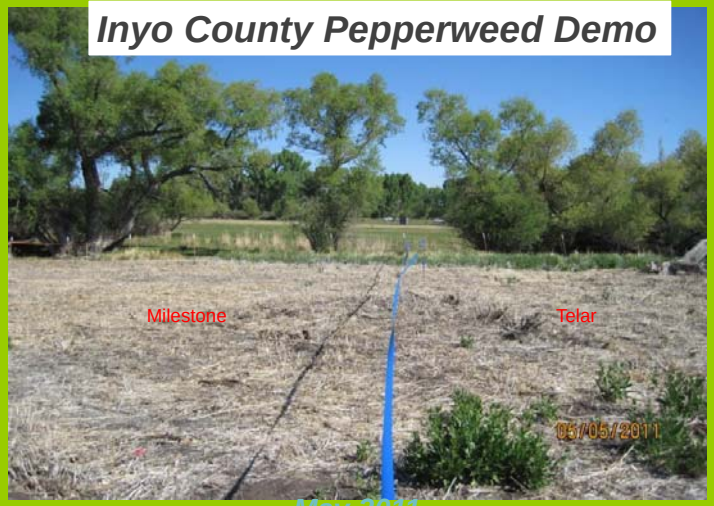
- **Rangeland & pastures**
- **Conservation Reserve Program acres**
- **Non-cropland areas** (such as roadsides)
- Non-irrigation ditch banks
- Natural areas such as wildlife management areas, wildlife openings, wildlife habitats, recreation areas, campgrounds, trailheads and trails
- Grazed areas in and around labeled sites.

"Up to the waters edge" labeling

Sutter Basin Milestone 7 oz 6 Months After Treatment

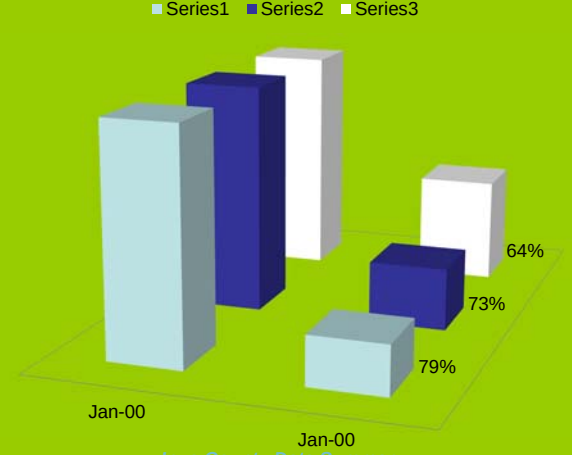
Perennial Pepperweed Control with Milestone Spot Treatment Modesto, CA

Inyo County Pepperweed Demo



May 2011

Perennial pepperweed Reduction – 1 year

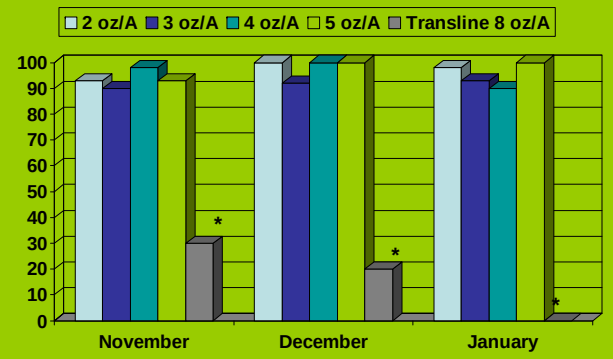


Inyo County Data Summary

Fiddleneck (Amsinckia menziesii)

Controlled by Milestone
Not controlled by Transline

Effect of treatment timing on coast fiddleneck (Amsinckia menziesii) control in Davis, California



Treatments from Nov 2002 to January 2003, final evaluation in March 2003

*** LSD (P=0.05)**

5 oz Milestone Distaff thistle San Luis Obispo County

Modesto Irrigation District

Marestail Control with Milestone

Milestone 7 oz/ac 4 weeks after treatment

Capstone®

- Excellent **grass safety**
- **Non-volatile**
- **CAUTION Signalword**
- Not a Restricted Use Pesticide
- **No grazing or haying restrictions**
  - Including lactating dairy animals
- Packaging: 2.5's, 30's, bulk

Capstone®

<u>Key Woody species controlled</u>

Tree of Heaven
Scotch broom
Poison oak
Himalayan blackberry

<u>Key Broadleaf weeds controlled</u>

Horseweed (marestail)
Thistles
Yellow starthistle
Knapweeds
Russian thistle (w/ glyphosate)

Capstone – Post Clean up and Selective Woody Plant Removal

May 25, 2013
Day of Application

August 4, 2013
71 DAT

Poison Oak on my walking trail

53

"Up to the waters edge" labeling

Capstone on Himalayan Blackberry
8 pints/Acre 43 DAA

Capstone @ 9 pt/ac - Applied November 2009 Evaluation May 2010

Tree of Heaven Demo in Visalia Foliar treatment 9 pints of Capstone/acre

Capstone on Tree of Heaven 7 months after treatment

Capstone on Tree of Heaven 26 months after treatment Visalia Highway 198 Photo Taken Nov 2nd, 2010

Capstone on Tree of Heaven 49 months after treatment Visalia Highway 198 Photo Taken Oct 24th, 2012

Capstone on Tree of Heaven 54 Months after Treatment Photo Taken March 2013

Woody Plant Post Option Vista XRT with Garlon

62

Selective Post-emergent Removal of Fast Growing Hardwoods such as Cherry, etc.

Vista XRT/Garlon Combo Post-emergent Option

Vista XRT SPECIALTY HERBICIDE

Garlon 4 Ultra SPECIALTY HERBICIDE

64

Salt Cedar(Tamarix Spp.)

- Very invasive
- Uses lots of H20 but thrives in dry conditions
- Accumulates salts in tissues and releases into soil

Salt Cedar(Tamarix spp.)

Basal Bark:
Garlon® 4 Ultra 25 to 30% in basal
— or Pathfinder® II specialty herbicide

Cut stump
Garlon 4 Ultra undiluted to cut surfaces any time of year.

Foliar:
After resprouts are at least 3 to 4 ft.
Milestone® Specialty Herbicide at 7 oz
Or Capstone at 1 gal/ac or equivalent

I'm out of time! Thank You!

Capstone on Scotch Broom – Nor CA 2010 Trial – 9 MAT

Capstone – Post Clean up and Selective Woody Plant Removal

May 25, 2013
Day of Application

August 4, 2013
71 DAT

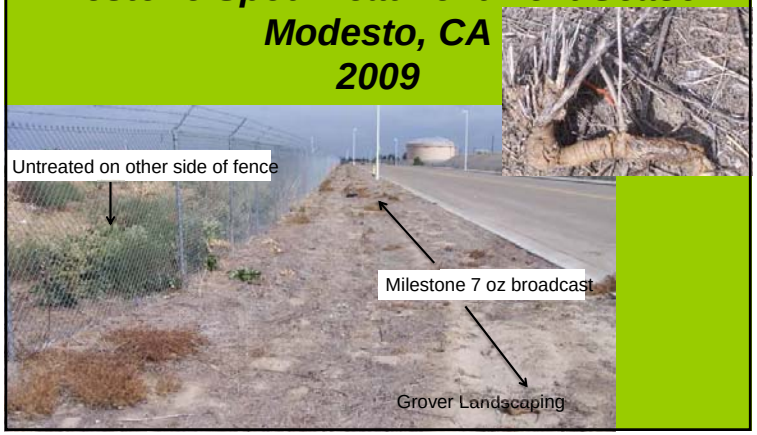
70

Perennial Pepperweed (Lepidium latifolium)

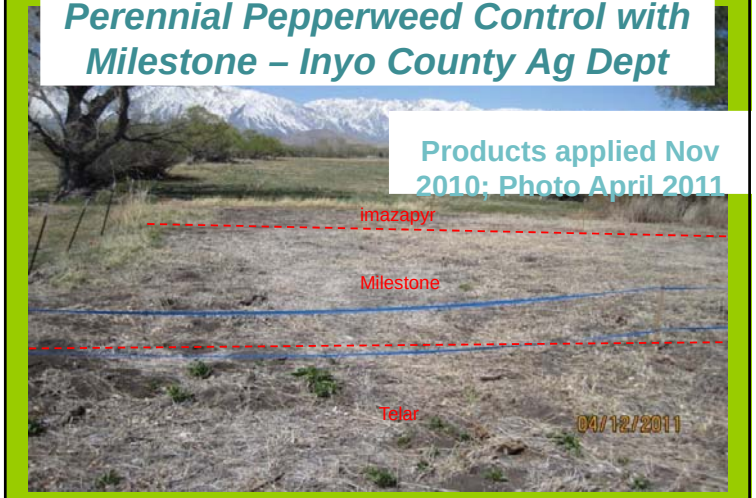
Perennial Pepperweed (*Lepidium latifolium*)

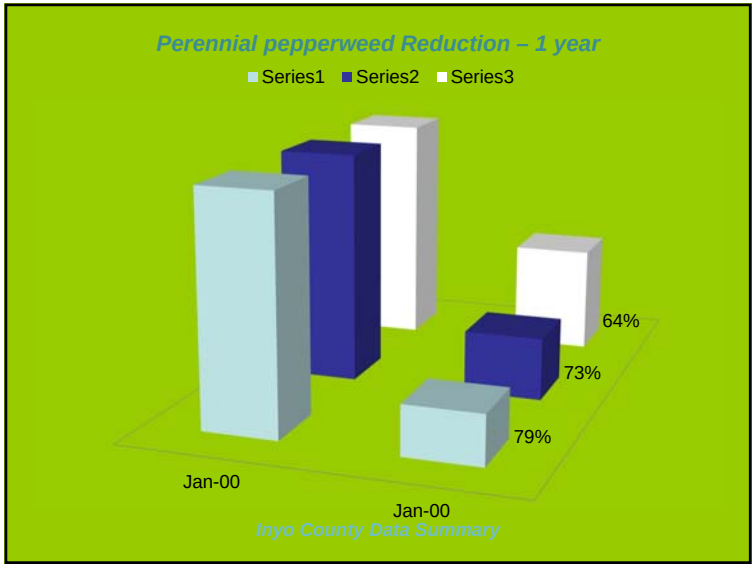
- Brassicaceae
- Grows in many habitats especially moist or seasonally wet.
- Forms large dense stand displacing desirable veg.
- Can infest entire stream corridors.
- Perennial mustard with large storage tubers – cannot kill the plant without killing the tuber and the seed bank in nearby soil

Perennial Pepperweed Control with Milestone Broadcast followed by Milestone Spot Treatment Next Season Modesto, CA 2009

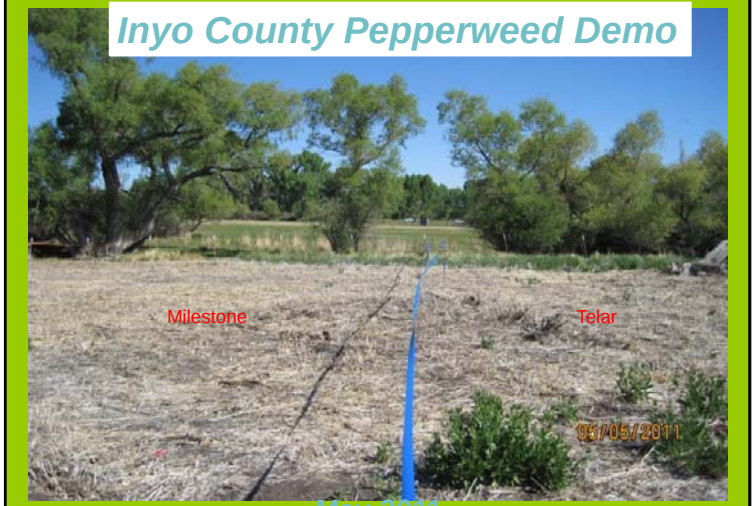


Perennial Pepperweed Control with Milestone – Inyo County Ag Dept





Inyo County Pepperweed Demo



May 2011

Aminopyralid Stewardship

- Labeled for “non-crop” areas only
- ***Please stay out of grapes, vegetables, cotton, alfalfa, soybeans, ornamentals, fruit trees and other desirable trees***
- Always read the product label for specifics
  - Don’t mulch treated manure or hay
- Sprayer cleanout protocol

Milestone® herbicide Guidelines for Use Around Woody Plants Can I use Milestone® herbicide for weed control under trees?

Guidelines for Use Around Woody Plants

Can I use Milestone® VM herbicide for weed control under trees?
Aminopyralid, the active ingredient in Milestone VM herbicide, has limited activity on woody species, including trees, when applied to the soil under the canopy. While it would be unlikely for broadcast applications of labeled rates to actually kill a mature tree (except legume species), there could be some leaf curling/cupping or other damage typical of growth regulator herbicides. Therefore, Milestone VM should **NOT** be used over the top of desirable trees. Milestone VM can be used **ONLY** as a directed spray under the canopy, or within the dripline, of certain trees; but not under desirable legume trees/shrubs.

Milestone VM CAN BE USED as an under-canopy soil application for the following trees:

Common name	Scientific name	Common name	Scientific name
alder	*Alnus rubrus*	maple	*Acer spp.*
ash	*Fraxinus spp.*	oaks	*Quercus spp.*
aspen	*Populus spp.*	poplar	*Populus spp.*
black cherry	*Prunus serotina*	southern yellow pine	*Pinus spp.* (southern)
cottonwood	*Populus spp.*	sweetgum	*Liquidambar styraciflua*
dogwood	*Cornus spp.*	sycamore	*Platanus occidentalis*

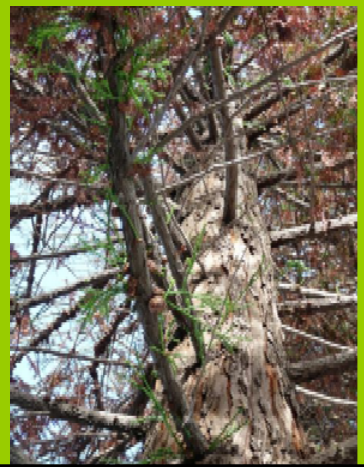
Milestone Drift into Alfalfa

Aminopyralid Phytotoxicity in Grapes

Milestone Application under Landscape Canopy – Unlabeled Use

Growth Regulator Galling in Redwood

New Growth & GR Galling in Affected Redwood

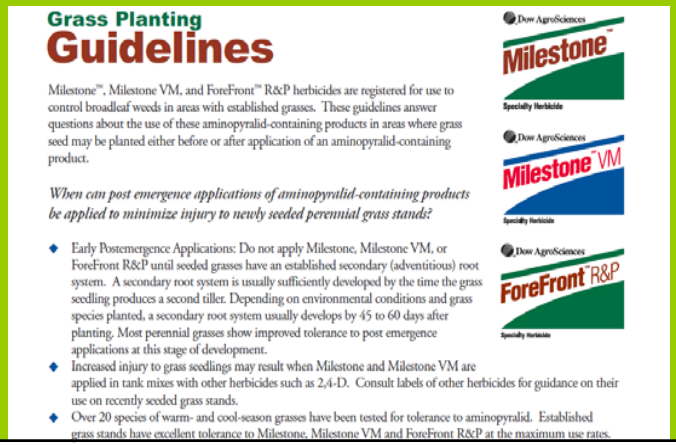


Milestone as a Pre-emergent for Medusahead Control: Technical Update

Rick Miller

Dow AgroSciences

Milestone can affect newly germinating grasses



Grass Planting
Guidelines

Milestone™, Milestone VM, and ForeFront™ R&P herbicides are registered for use to control broadleaf weeds in areas with established grasses. These guidelines answer questions about the use of these aminopyralid-containing products in areas where grass seed may be planted either before or after application of an aminopyralid-containing product.

When can post emergence applications of aminopyralid-containing products be applied to minimize injury to newly seeded perennial grass stands?

- Early Postemergence Applications: Do not apply Milestone, Milestone VM, or ForeFront R&P until seeded grasses have an established secondary (adventitious) root system. A secondary root system is usually sufficiently developed by the time the grass seedling produces a second tiller. Depending on environmental conditions and grass species planted, a secondary root system usually develops by 45 to 60 days after planting. Most perennial grasses show improved tolerance to post emergence applications at this stage of development.
- Increased injury to grass seedlings may result when Milestone and Milestone VM are applied in tank mixes with other herbicides such as 2,4-D. Consult labels of other herbicides for guidance on their use on recently seeded grass stands.
- Over 20 species of warm- and cool-season grasses have been tested for tolerance to aminopyralid. Established grass stands have excellent tolerance to Milestone, Milestone VM and ForeFront R&P at the maximum use rates.

Dow AgroSciences Milestone™ Specialty Herbicide
Dow AgroSciences Milestone™ VM Specialty Herbicide
Dow AgroSciences ForeFront™ R&P Specialty Herbicide

Medusahead Control with Milestone History of Efforts to Date

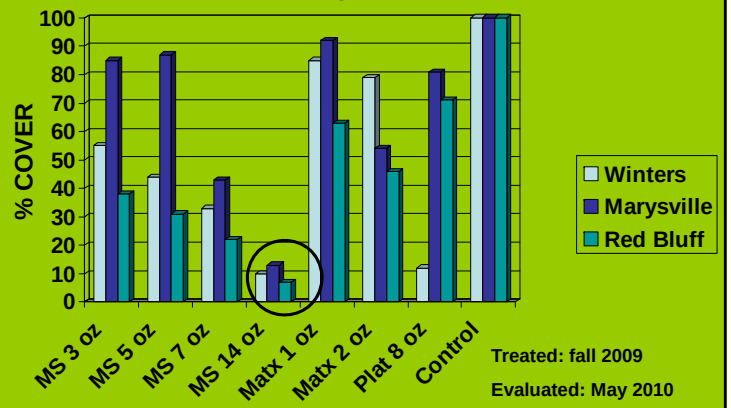
- UC Davis Microplot Trial 2007
- UC Davis Greenhouse studies 2008
- UC Davis trials applied via quad fall of 2009
- Cosgrave Ranch demo applied via quad 2009
- Mariposa County Ranch application Sept 2011
- Sachau Ranch application Sept 2011

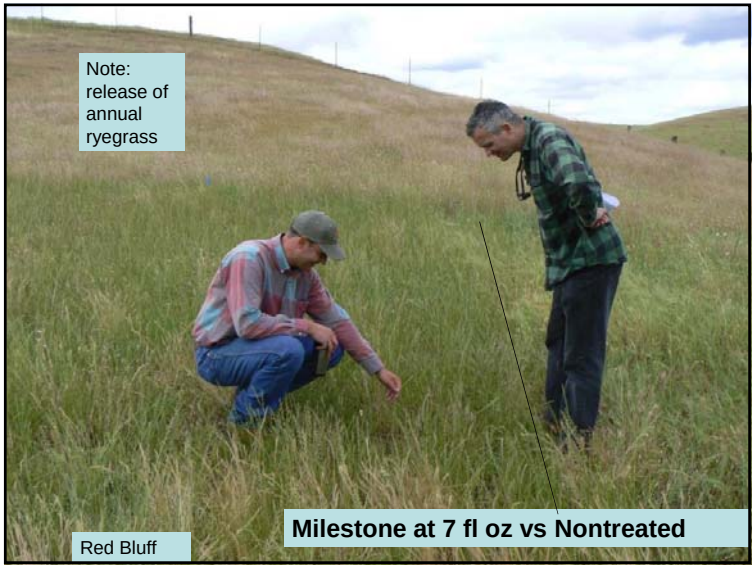
Medusahead trials in CA
Joe DiTomaso and Guy Kyser, UC Davis

Methods and Materials

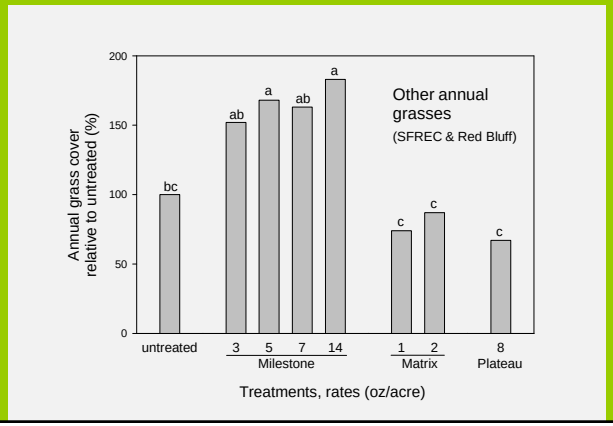
- Applications pregermination/preemergence
- 3 locations
  - Bobcat Ranch, Winters
    - applied Oct 9, 2009
  - Sierra Foothills Research & Extension Center, Marysville
    - Applied Oct 8, 2009
  - Gallatin Ranch, Red Bluff
    - Applied Sept 28, 2009
- 20 GPA

Medusahead Cover Compared with Untreated Control May 2010





Annual grass cover taken in May following herbicide applications



Medusahead Demonstrations with Milestone at 7 oz/acre

Medusahead Treated in October with 7 oz Milestone

Grass Release Following April In Treated Areas

Cosgrave Ranch, Calaveras County Treated 10/19/2009; photo 4/27/2010 – re Release of soft brome , annual ryegrass and other desirable grasses

Supplemental Label for Medusahead Control Issued in 2011

Product Bulletin

Dow AgroSciences

Dow AgroSciences LLC 9330 Zionsville Road Indianapolis, IN 46268-1054 USA

Milestone®

EPA Reg. No. 62719-519

2(ee) Recommendation†

For Distribution and Use in the States of Arizona, California, Colorado, Idaho, Oregon, Nevada, Utah, Wyoming

For Control or Suppression of Medusahead Rye and Other Winter Annual Grasses

ATTENTION

† This recommendation is permitted under FIFRA 2(ee) and has not been submitted to or approved by the EPA.

- It as a violation of Federal law to use this product in a manner inconsistent with its labeling.
- Read and follow all applicable directions for use, precautions and limitations on the product label attached to the container for Milestone® herbicide.

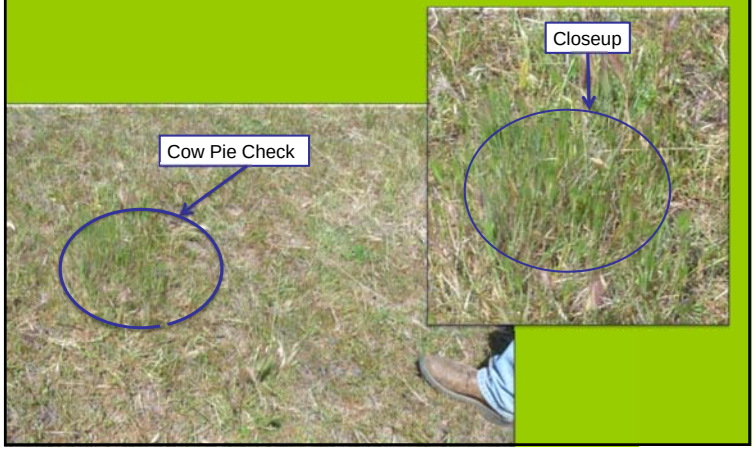
Refer to Milestone® herbicide product package label for further use directions including requirements for

Sachau Ranch, Livermore, CA Treated with 7 oz Milestone via Spray Service on September 12, 2011

Flowering grasses collected from the Sachau Ranch on April 18, 2012: Bromus sp. (upper specimen) and Hordeum murinum (wild barley, lower specimens).

Medusahead in untreated section of the Sachau Ranch on May 25, 2012

Sachau Ranch 19 months after Treatment 7 oz/acre Milestone



Medusahead Control at the Vineyard Mountain Ranch

April 11, 2013

San Miguel, CA

Rye Grass Release with 7 oz Milestone

Spray Skips Tell the Story

Medusahead Stunts Production inside a spray skip, fiddleneck at back of skip

Fiddleneck and Medusahead Dominate a Spray Skip

Nathan Sanders and Mike Hollarman

Rye Grass Release with 7 oz Milestone

Vineyard Mountain Ranch Spray Skips Tell the Story

Vineyard Mountain Ranch Treated with 7 oz Milestone Oct 2012 -- Photo April 2013

Vineyard Mountain Ranch
May 17, 2013

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Vineyard Mountain Ranch
May 17, 2013

Capstone – Post Clean up and Selective Woody Plant Removal

May 25, 2013
Day of Application

August 4, 2013
71 DAT

111

Poison Hemlock 21 DAT with Capstone 9 pts/acre

Tree of Heaven Demo in Visalia
Foliar treatment
9 pints of Capstone/acre

Capstone on Tree of Heaven
7 months after treatment
Visalia Highway 198

Capstone on Tree of Heaven
2+ years after treatment
Visalia Highway 198
Photo Taken Nov 2nd, 2010

Capstone on Tree of Heaven
4+ years after treatment
Visalia Highway 198
Photo Taken Oct 24th, 2012

Capstone on Tree of Heaven
4.5 years after treatment
Visalia Highway 198
Photo Taken March 2013

Milestone as a Pre-emergent for Medusahead Control: Technical Update

Rick Miller
Dow AgroSciences

Milestone can affect newly germinating grasses

Grass Planting
Guidelines

Dow AgroSciences Milestone™ Specialty Herbicide
Dow AgroSciences Milestone™ VM Specialty Herbicide
Dow AgroSciences ForeFront™ R&P Specialty Herbicide

Milestone™, Milestone VM, and ForeFront™ R&P herbicides are registered for use to control broadleaf weeds in areas with established grasses. These guidelines answer questions about the use of these aminopyralid-containing products in areas where grass seed may be planted either before or after application of an aminopyralid-containing product.

When can post emergence applications of aminopyralid-containing products be applied to minimize injury to newly seeded perennial grass stands?

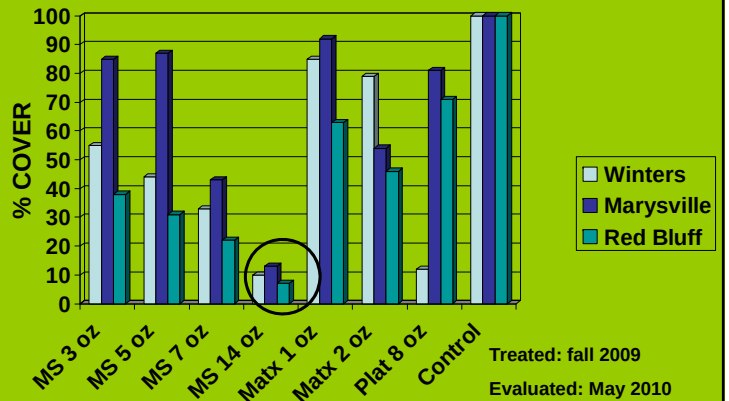
- Early Postemergence Applications: Do not apply Milestone, Milestone VM, or ForeFront R&P until seeded grasses have an established secondary (adventitious) root system. A secondary root system is usually sufficiently developed by the time the grass seedling produces a second tiller. Depending on environmental conditions and grass species planted, a secondary root system usually develops by 45 to 60 days after planting. Most perennial grasses show improved tolerance to post emergence applications at this stage of development.
- Increased injury to grass seedlings may result when Milestone and Milestone VM are applied in tank mixes with other herbicides such as 2,4-D. Consult labels of other herbicides for guidance on their use on recently seeded grass stands.
- Over 20 species of warm- and cool-season grasses have been tested for tolerance to aminopyralid. Established grass stands have excellent tolerance to Milestone, Milestone VM and ForeFront R&P at the maximum use rates.

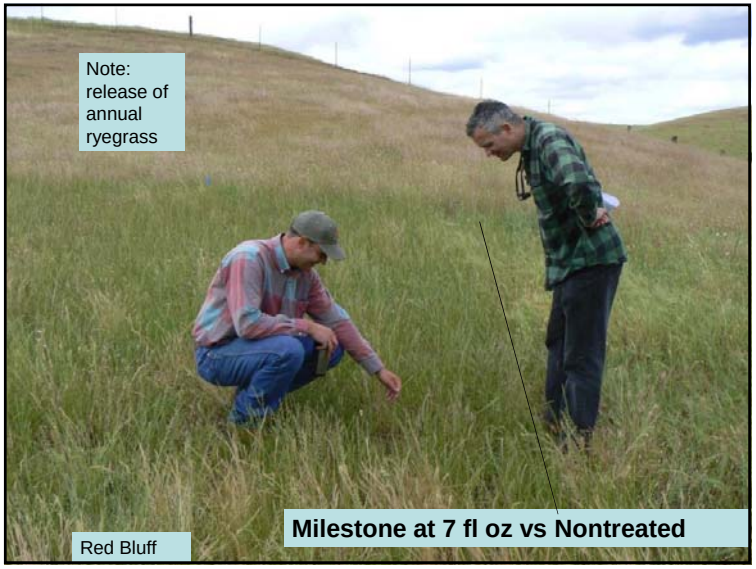
Medusahead Control with Milestone History of Efforts to Date

- UC Davis Microplot Trial 2007
- UC Davis Greenhouse studies 2008
- UC Davis trials applied via quad fall of 2009
- Cosgrave Ranch demo applied via quad 2009
- Mariposa County application Sept 2011
- Sachau Ranch application Sept 2011
- Vineyard Mountain Ranch Oct 2012

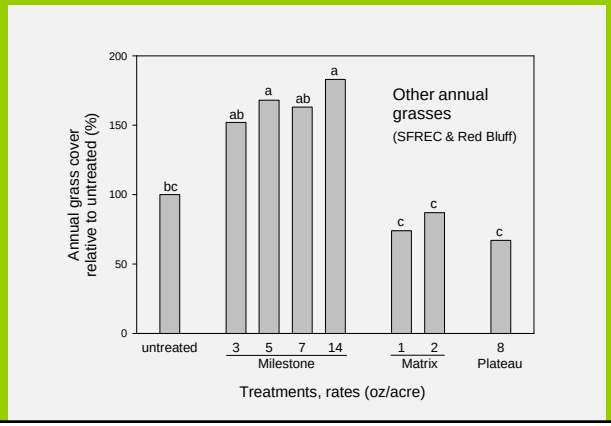
Medusahead trials in CA
Joe DiTomaso and Guy Kyser, UC Davis

Medusahead Cover Compared with Untreated Control May 2010





Annual grass cover taken in May following herbicide applications



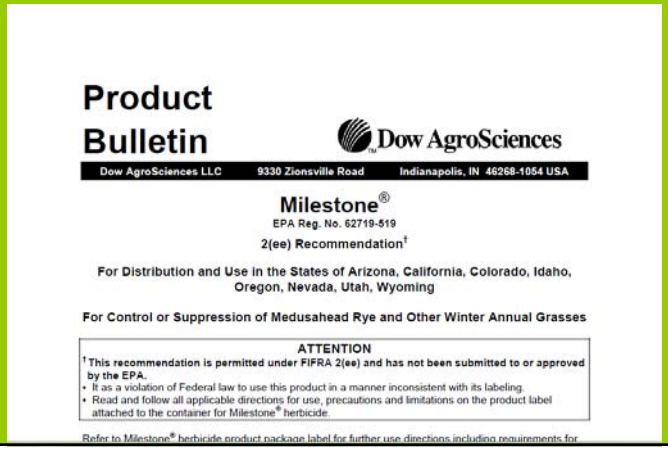
Medusahead Demonstrations with Milestone at 7 oz/acre

Medusahead Treated in October with 7 oz Milestone

Grass Release Following April In Treated Areas

Cosgrave Ranch, Calaveras County Treated 10/19/2009; photo 4/27/2010 – re Release of soft brome , annual ryegrass and other desirable grasses

Supplemental Label for Medusahead Control Issued in 2011



Product Bulletin

Dow AgroSciences

Dow AgroSciences LLC 9330 Zionsville Road Indianapolis, IN 46268-1054 USA

Milestone®

EPA Reg. No. 62719-519

2(ee) Recommendation†

For Distribution and Use in the States of Arizona, California, Colorado, Idaho, Oregon, Nevada, Utah, Wyoming

For Control or Suppression of Medusahead Rye and Other Winter Annual Grasses

ATTENTION

† This recommendation is permitted under FIFRA 2(ee) and has not been submitted to or approved by the EPA.

- It as a violation of Federal law to use this product in a manner inconsistent with its labeling.
- Read and follow all applicable directions for use, precautions and limitations on the product label attached to the container for Milestone® herbicide.

Refer to Milestone® herbicide product package label for further use directions including requirements for

Sachau Ranch, Livermore, CA
Treated with 7 oz Milestone via Spray Service on September 12, 2011

Dan Sachau, Sachau Ranch
Livermore, CA 3.5" rain season to date

Sachau Ranch 19 months after Treatment 7 oz/acre Milestone

Cow Pie Check (closeup)

Medusahead Control at the Vineyard Mountain Ranch

Medusahead Infestations treated with 7 oz/acre Milestone October 2012

Photos taken April 11, 2013

San Miguel, CA

Rye Grass Release with 7 oz Milestone

Spray Skips Tell the Story

Medusahead Stunts Production inside a spray skip, fiddleneck at back of skip

Fiddleneck and Medusahead Dominate a Spray Skip

Nathan Sanders, Ranch Manager Mike Hollarman, CPS

Vineyard Mountain Ranch May 17, 2013

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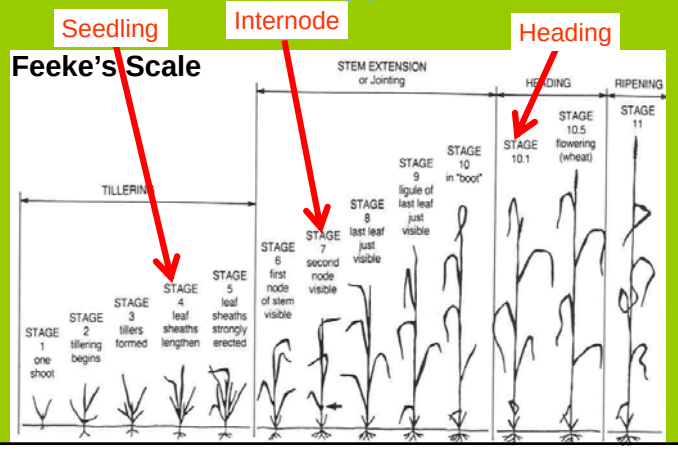
Plant growth stages for timings of herbicide applications



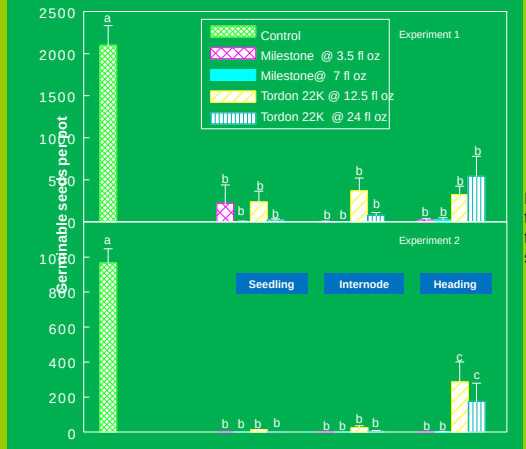
Herbicide Effects on Seed Development

These are Japanese brome hulls* but the same lack of seed development occurs with medusahead and ventenata

Normal Seeds | **Milestone treated plants**

*** see research data on previous slide**

Greenhouse results-Medusahead



Different letters on the bars indicate the means are statistically different