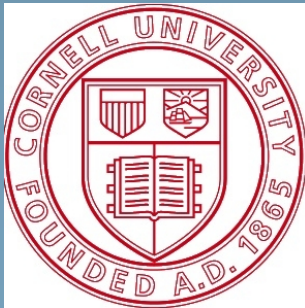


# Weeds: IPM Strategies for Long-Term Prevention of Weeds

July 11<sup>th</sup>, 2017



Jenny Kao-Kniffin  
Associate Professor  
Cornell University

# IPM for Long-Term Weed Management

## Cultural control

- Repetitive over-seeding in schools playing fields
- Organic amendments in lawns

## Mechanical control

- Thermal weeding project with Dr. Andy Senesac (LIHREC)

## Chemical control

- Soft chemistries (minimal and reduced risk)
- Microbial-derived compounds for weed control

## Biological control

- Microbial communities that modulate plant traits
- Commercial bioherbicides in turf landscapes

Go to: <http://safesportsfields.cals.cornell.edu/>

The screenshot shows the Cornell University Sports Field Management website. The browser address bar displays [safesportsfields.cals.cornell.edu](http://safesportsfields.cals.cornell.edu/). The page header includes the Cornell University logo and a search bar. The main navigation menu lists: Home, Soils, Grasses, Routine care, Pests, Synthetic turf, Management schedules, and Resources. The page title is "Sports Field Management" with the subtitle "Maintaining safe sports fields".

**Investing in Safe Sports Fields**

Children, youth and adults use school grounds and community parks sports for recreation and other health-improving outdoor activities. New York State alone has more 40,000 acres devoted to these uses.

The challenge for sports turf managers is to provide safe, functional and aesthetically pleasing fields.

This website brings you the latest best management practices for managing sports fields and resources for all who care for and use sports fields.

[Learn more.](#)

**Manage for safety**

Explore how you can manage your fields for maximum safety:

- [Managing soils](#)
- [Choosing grasses](#)
- [Routine care](#)
- [Managing pests](#)
- [Synthetic turf](#)
- [Management schedules](#)


**For Coaches and ADs**

To prevent injuries and help your athletes play their best, you need safe, high-quality turf. [Learn more.](#)

**For Administrators**

Your support of Best Management Practices for turf is essential to foster safe playing fields. [Learn more.](#)

**Mowing**



**SEARCH**

**Cornell turfgrass**

**We've moved!**  
06-07-2016 11:23  
The [Cornell Turfgrass Program website...](#) [Read Post](#)

**'Forecast' weather update for May 26**  
06-01-2016 09:00  
Weekly weather update for professional turf managers from... [Read Post](#)

**Comments, suggestions, feedback?**

[Use this form](#) to contact us.

# Cultural Control: Optimizing grass density

**Repetitive seeding can improve grass competition against weeds**

**Add grass seeds at various rates of 2 to 6 lbs/1,000 ft<sup>2</sup>**

**Repetitively seed with perennial ryegrass starting early Fall  
(late August to early September)**

**David Chinery and Frank Rossi (CCE Rensselaer County)**



# Repetitive Over-Seeding in Schools & Institutions (ROSSI) in K-12 school playing fields

## Project Leaders and Collaborators:

### Cornell University

- Jenny Kao-Kniffin
- Frank Rossi
- Kyle Wickings
- Mary Thurn
- Marty Petrovic

### NYS IPM

- Jennifer Grant
- Joellen Lampman
- Lynn Braband

### Cornell Cooperative Extension

- Jennifer Stengle (CCE Putnam County)
- Tamson Yeh (CCE Suffolk County)

### Univ. of Connecticut

- Victoria Wallace

### State of Maine

- Kathy Murray

### Scotts Miracle-Gro Company

- Mark Slavens, VP

### North Syracuse Central Schools

- Ike Hunter



Baldwinsville soccer field, Summer 2015

# Use appropriate grass species and varieties

	<b>Kentucky Bluegrass</b>	<b>Perennial Ryegrass</b>	<b>Tall Fescue</b>	<b>Fine Fescue</b>
<b>Shade tolerance</b>	Poor	Poor	Good	Excellent
<b>Drought tolerance</b>	Poor	Poor	Some	Some
<b>Wear tolerance</b>	Good	Good	Good	Poor
<b>Growth habit</b>	Rhizomatous	Bunch	Bunch	Bunch
<b>Leaf texture</b>	Medium-Fine	Medium	Coarse	Very fine
<b>Seeding rate (lb./1000 ft.<sup>2</sup>)</b>	1 to 2	5 to 9	5 to 9	3 to 5
<b>Nitrogen fertilizer (lb N/1,000 ft.<sup>2</sup>/yr)</b>	3 to 4	2 to 6	2 to 4	1 to 2

# Pest suppressive tall fescues

**Several tall fescue varieties with endophytic fungi show suppression of grub and plant pathogenic nematode damage**

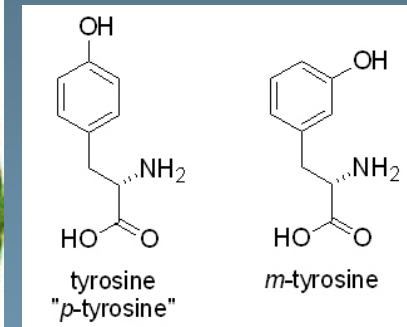


Photo: [www.midtennturf.com](http://www.midtennturf.com)

**Alkaloid compounds are produced by endophytic fungi and released from the roots of tall fescue to influence pest resistance**



# Weed suppressive fine fescues



**Allelopathic  
compound**

Photo: [www.hort.cornell.edu/departments/faculty/weston](http://www.hort.cornell.edu/departments/faculty/weston)

**Several fine fescue varieties exude m-tyrosine from roots  
(Intrigue and Columbra II available through John Deere)**



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# Mechanical weed control: Flame weeding

Flame weeding eliminates weeds with intense heat



photo: [www.growingproduce.com](http://www.growingproduce.com)



photo: [www.greenhousecatalog.com](http://www.greenhousecatalog.com)



photo: [www.rtol.net](http://www.rtol.net)

- Effective control of young weeds (1" to 4")
- Best at eliminating annual weeds and depletes the weed seedbank

# Baseball in-fields and no herbicides



**Flame weeding torches are available in 4- or 5- torch systems**



**Rascal Pro Blade with finishing rake for baseball diamond in-fields**

# Mechanical Weed Control: Brush Cutters vs. Fence Line Trimmers?



photo: [www.pllps.org](http://www.pllps.org)



photo: [www.todaysmower.com](http://www.todaysmower.com)

- Brush cutters can be used on any fence line
- Fence line trimmers work best with 3 inch raised fences
- Both require continued maintenance—perennials will regenerate

# Mechanical weed control: Install Weed Suppressive Fencelines



photo: [www.calus-mcclain.blogspot.com](http://www.calus-mcclain.blogspot.com)



photo: [www.grandview26blogspot.com](http://www.grandview26blogspot.com)



photo: [www.weedseal.com](http://www.weedseal.com)

**Place weed barrier fabric, rubber lining,  
plastic lining, or mulch against fence lines**



photo: [www.mowstrip.com](http://www.mowstrip.com)

# IPM for Long-Term Weed Management

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# Chemical control: Minimal and reduced risk herbicides

Strategic use of chemical control to manage weeds



Photo: [www.linders.com](http://www.linders.com)



Photo: [earthfix.opb.org](http://earthfix.opb.org)

Chemical control includes softer chemistries

# Biological control: Bioherbicides for weeds in turf



Commercial name: Sarritor

Organism: *Sclerotinia minor* (fungus native to N. America)

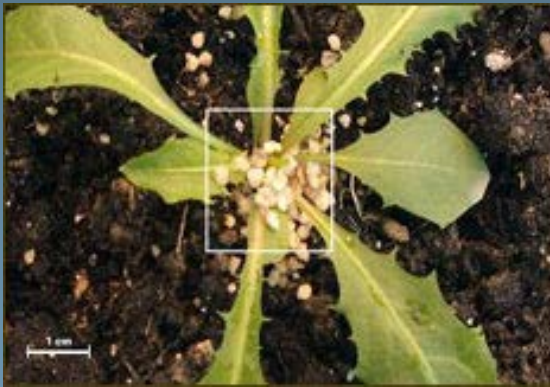


photo: [www.sarritor.ca](http://www.sarritor.ca)

- Controls broadleaf weeds (dandelions, plantains, and clover)
- Needs moisture and 64-75° F temperatures
- Fungus grows from granules and infects weed



# Identify Weeds using the Internet

http://turfweeds.cals.cornell.edu/

ISI Web of Knowledge... Pesticide Product, Ingr... Delete Worldwide Wholesale ... KFS log in myCornell Google Scholar


Cornell University Search Cornell go

Turfgrass and Landscape Weed ID

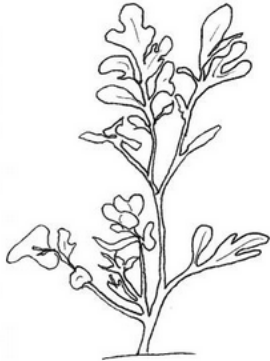
Weeds ID Resources About

Introduction and Instruction

Grass-like



Broadleaf



8:20 PM  
2/21/2015

Cornell has a new Weed ID Tool specific to NYS

# Select plant traits on the right side

The screenshot shows a web browser window with the address bar displaying <http://turfweeds.cals.cornell.edu/>. The browser's address bar also shows several search engines: ISI Web of Knowledge, Pesticide Product Ingr..., Delete, Worldwide Wholesale, KFS log in myCornell, and Google Scholar.

The main content area is divided into two sections. On the left, a sidebar contains several trait selection categories, each with a list of options and their respective counts:

- Inflorescence location**
- Inflorescence color**
  - White (41)
  - Yellow (33)
  - Green (22)
  - Purple (19)
  - Pink (12)
  - Red (4)
  - Blue (2)
  - Brown (3)
  - Violet (3)
  - Black (1)
- Stature**
- Leaf margin**
- Leaf division**

On the right, a grid of plant images is displayed, each with a title and scientific name:

- Velvetleaf** (*Abutilon theophr...*)
- Common yarrow** (*Achillea millefol...*)
- Tree of heaven** (*Ailanthus altissi...*)
- Garlic mustard** (*Alliaria petiolat...*)
- Tumble pigweed** (*Amaranthus albus*)
- Powell amaranth** (*Amaranthus powell...*)
- Redroot pigweed** (*Amaranthus retrof...*)
- Common ragweed** (*Ambrosia artemisi...*)
- Giant ragweed** (*Ambrosia trifida*)
- Porcelain berry** (*Ampelopsis brevip...*)
- Spurred anoda** (*Anoda cristata*)
- Mayweed chamomile** (*Anthemis cotula*)
- Wild chervil** (*Anthriscus sylves...*)
- Hemp dogbane** (*Apocynum cannabin...*)
- Common burdock** (*Arctium minus*)
- Common milkweed** (*Asclepias syriaca*)

The bottom of the browser window shows the Windows taskbar with various application icons and the system tray displaying the time as 8:23 PM on 2/21/2015.

# Check off boxes to narrow down selection

http://turfweeds.cals.cornell.edu/

ISI Web of Knowledge... Pesticide Product, Ingr... Delete Worldwide Wholesale ... KFS log in myCornell Google Scholar

**Stature**

Inflorescence location

Inflorescence color

- White (41)
- Yellow (33)
- Green (22)
- Purple (19)
- Pink (12)
- Red (4)
- Blue (2)
- Brown (3)
- Violet (3)
- Black (1)

Leaf margin

Leaf division

**Velvetleaf**  
*Abutilon theophrasti...*

**Common yarrow**  
*Achillea millefol...*

**Tree of heaven**  
*Ailanthus altissi...*

**Garlic mustard**  
*Alliaria petiolat...*

**Tumble pigweed**  
*Amaranthus albus*

**Powell amaranth**  
*Amaranthus powell...*

**Redroot pigweed**  
*Amaranthus retrof...*

**Common ragweed**  
*Ambrosia artemisi...*

**Giant ragweed**  
*Ambrosia trifida*

**Porcelain berry**  
*Ampelopsis brevip...*

**Spurred anoda**  
*Anoda cristata*

**Mayweed chamomile**  
*Anthemis cotula*

**Wild chervil**  
*Anthriscus sylves...*

**Hemp dogbane**  
*Apocynum cannabin...*

**Common burdock**  
*Arctium minus*

**Common milkweed**  
*Asclepias syriaca*

turfweeds.cals.cornell.edu/plants?field\_plant\_schema[0]=Broadleaf&f[0]=field\_plant\_schema:Broadleaf#leaf margin

8:23 PM  
2/21/2015

Click on “stature”

# Continue to narrow down your choices

http://turfweeds.cals.cornell.edu/

ISI Web of Knowledge... Pesticide Product, Ingr... Delete Worldwide Wholesale ... KFS log in myCornell Google Scholar

**Inflorescence location**

**Inflorescence color**

- White (41)
- Yellow (33)
- Green (22)
- Purple (19)
- Pink (12)
- Red (4)
- Blue (3)
- Brown (3)
- Violet (3)
- Black (1)

**Stature**

- Upright (38)
- Spreading (21)
- Clump (12)
- Vine (10)
- Rosette (2)

 <b>Velvetleaf</b> <i>Abutilon theophrasti...</i>	 <b>Common yarrow</b> <i>Achillea millefol...</i>	 <b>Tree of heaven</b> <i>Ailanthus altissi...</i>	 <b>Garlic mustard</b> <i>Alliaria petiolat...</i>
 <b>Tumble pigweed</b> <i>Amaranthus albus</i>	 <b>Powell amaranth</b> <i>Amaranthus powell...</i>	 <b>Redroot pigweed</b> <i>Amaranthus retrof...</i>	 <b>Common ragweed</b> <i>Ambrosia artemisi...</i>
 <b>Giant ragweed</b> <i>Ambrosia trifida</i>	 <b>Porcelain berry</b> <i>Ampelopsis brevip...</i>	 <b>Spurred anoda</b> <i>Anoda cristata</i>	 <b>Mayweed chamomile</b> <i>Anthemis cotula</i>
 <b>Wild chervil</b>	 <b>Hemp dogbane</b>	 <b>Common burdock</b>	 <b>Common milkweed</b>

The “stature” feature then provides several options

# Continue to narrow down your choices

http://turfweeds.cals.cornell.edu/

Broadleaf  Grass-like (0)










**Inflorescence location**

**Inflorescence color**

- White
- Yellow (8)
- Pink (6)
- Purple (4)
- Green (2)
- Red (2)
- Violet (2)

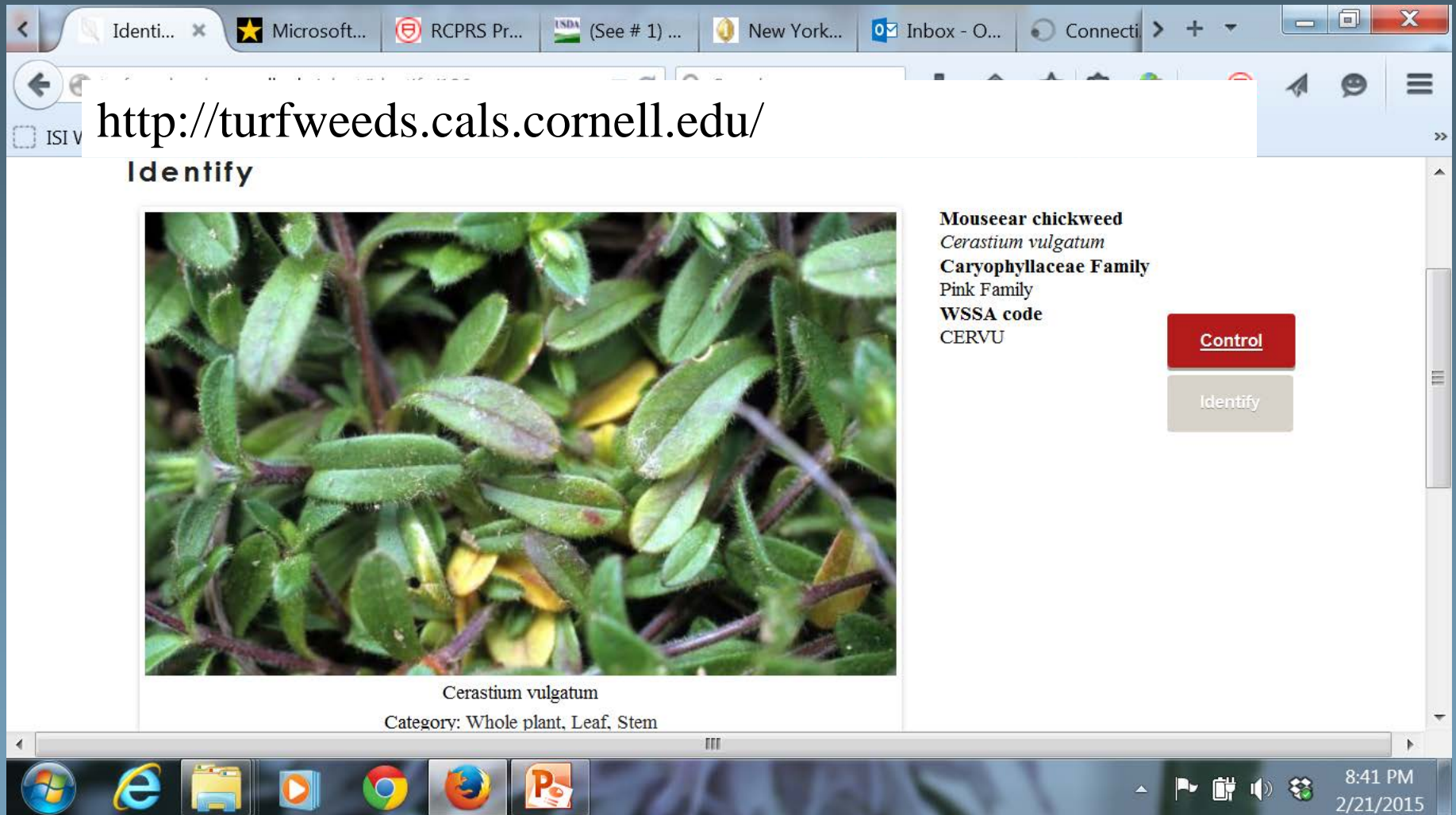
**Stature**

- Spreading
- Upright (4)
- Clump (1)

 <b>Lawndaisy</b> <i>Bellis perennis</i>	 <b>Mouseear chickweed</b> <i>Cerastium vulgatu...</i>	 <b>Wild cucumber</b> <i>Echinocystis loba...</i>	 <b>Spotted spurge</b> <i>Euphorbia maculat...</i>
 <b>Catchweed bedstraw</b> <i>Galium aparine</i>	 <b>Smooth bedstraw</b> <i>Galium mullugo</i>	 <b>Common mallow</b> <i>Malva neglecta</i>	 <b>Horsenettle</b> <i>Solanum carolinen...</i>
			

Clicking on “spreading” stature and “white” flowers gives you nine plant species

# Example: Mouse chickweed control



The screenshot shows a web browser window with the URL <http://turfweeds.cals.cornell.edu/>. The page is titled "Identify" and features a large photograph of a Mouseear chickweed plant. To the right of the photo, the following information is displayed:

- Mouseear chickweed**
- Cerastium vulgatum*
- Caryophyllaceae Family**
- Pink Family
- WSSA code**
- CERVU

Below this information are two buttons: a red button labeled "Control" and a grey button labeled "Identify". Below the photograph, the text "Cerastium vulgatum" and "Category: Whole plant, Leaf, Stem" is visible. The browser's taskbar at the bottom shows various application icons and the system clock indicating 8:41 PM on 2/21/2015.

If your mystery weed is a chickweed, click on the red button to learn about control options

# Example: Mouse chickweed control

The screenshot shows a web browser window with the address bar displaying <http://turfweeds.cals.cornell.edu/>. The page content includes the following information:

Cerastium vulgatum  
Category: [Leaf](#), [Stem](#)  
Photo credit: Theodore Webster, USDA ARS

Below this information are three columns of control options, each enclosed in a red dotted box:

- Conventional**
  - Carfentrazone + MCPA + MCPP + dicamba (POST)
  - Clopyralid (POST) **Label**
  - Clopyralid + Triclopyr (POST)
  - Fluroxypyr (POST) **Label**
  - Iron HEDTA (POST) **Label**
  - Mesotrione\*\* (PRE, POST) **Label**
  - Sulfentrazone\*\* (POST) **Label**
  - \*\* Click on stars if present for additional notes
- Reduced Risk**
  - Acetic acid (POST) **Label**
  - Citrus oil (d-limonene) (POST) **Label**
  - Iron HEDTA (POST) **Label**
  - Pelargonic acid (POST)
  - Potassium salts of fatty acids (POST)
- Child Safe**
  - 2-Phenethyl propionate (POST)
  - Cinnamon (POST) **Label**
  - Cinnamon oil (POST)
  - Citric acid (POST)
  - Citric acid, malic acid, and clove oil (POST)
  - Cloves and clove oil (POST)
  - Corn gluten meal (PRE)
  - Eugenol (POST)
  - Lemongrass oil (POST) **Label**

The browser's taskbar at the bottom shows icons for Windows, Internet Explorer, File Explorer, VLC, Google Chrome, Firefox, and PowerPoint. The system tray on the right indicates the time is 8:44 PM on 2/21/2015.

The control options are displayed at the bottom. Click to obtain specific herbicide labels

# Example: Mouse chickweed control

Control ... PIMS ... Microsoft... RCPRS Pr... USDA (See # 1) ... New York... Inbox - C

pims.psur.cornell.edu/ProductResults.php?ProductName=M Search

ISI Web of Knowledge... Pesticide Product, Ingr... Delete Worldwide Wholesale ... KFS log in myCornell Google Scholar

PMEP **Product, Ingredient, and Manufacturer System** New York State Department of Environmental Conservation

Last update: 02/11/2015

## New York State Pesticide Products

[Return to Main Menu](#)

Printing[+] Print Selected Reset Selection Select All Records per page: 25 First Prev Records 1 – 1 of 1 Next Last  
Click a column label to sort by that column

	Product Name	EPA Registration Number	Company	Distributor	Restriction	LI Use	Labels
<input type="checkbox"/>	<a href="#">DUPONT MESOTRIONE 50WG HERBICIDE</a>	352-842	E.I. DU PONT DE NEMOURS AND COMPANY (352)			Yes	<a href="#">NYS EPA *</a>

Print Selected Reset Selection Select All First Prev Records 1 – 1 of 1 Next Last

[Top](#)

### DUPONT MESOTRIONE 50WG HERBICIDE

Label Information

8:46 PM 2/21/2015

Selection of an herbicide takes you to the PIMS website for pesticides registered in NYS



# Example: Mouse chickweed control

The screenshot shows a web browser window with the URL [pims.psur.cornell.edu/ProductResults.php?ProductName=M](http://pims.psur.cornell.edu/ProductResults.php?ProductName=M). The page title is "DUPONT MESOTRIONE 50WG HERBICIDE".

**Label Information**

State Label Information: [NYS Labels/Documents](#) Federal Label Information: [EPA Primary Labels](#) \*

**Product Information**

<b>Product Name:</b> DUPONT MESOTRIONE 50WG HERBICIDE	<b>EPA Registration Number:</b> 352-842
<b>Use:</b> Agricultural	<b>Type:</b> Herbicide
<b>Status:</b> Registered	<b>Toxicity Statement:</b> NONE
<b>Signal Word:</b> Caution	<b>Precautionary Statement:</b> Dermal (includes eye irritation)
<b>Flammable:</b> N	<b>Formulation:</b> Granular
<b>Restricted:</b> NONE	<b>Renewal Date:</b> 03/31/2015
<b>Nassau/Suffolk Use Allowed:</b> Yes	<b>Initial Registration Date:</b> 04/16/2012

**Ingredient Information**

AI Code	Prefix	Active Ingredient Name	Percent of AI
122990		<a href="#">MESOTRIONE</a>	50

**Contact Information**

The Windows taskbar at the bottom shows the time as 8:48 PM on 2/21/2015.

Selection of a product gives you the product information and a link to the NYS label

# Example: Mouse chickweed control

Control ... PIMS ... Microsoft... RCPRS Pr... USDA (See # 1) ... New York... Inbox - C

pims.psur.cornell.edu/LabelResults.php?ProductId=1728488 Search

ISI Web of Knowledge... Pesticide Product, Ingr... Delete Worldwide Wholesale ... KFS log in myCornell Google Scholar

## Product, Ingredient, and Manufacturer System

Last update: 02/11/2015

### New York State Product Labels

- [Return to Main Menu](#)

Product: **DUPONT MESOTRIONE 50WG HERBICIDE**

Registraton Number: **352-842**

Click a column label to sort by that column Records per page: 25 | First | Prev | Records 1 – 2 of 2 | Next | Last

	Document Type	Accepted Date	Label/Document ID	Primary Label/Document ID
<a href="#">View</a>	Primary Label	08/29/2014	539802	
<a href="#">View</a>	Primary Label	04/16/2012	531027	

First | Prev | Records 1 – 2 of 2 | Next | Last

**Note:** These NYS pesticide product registration data are intended for **information purposes** only. If you are concerned about the status of a product, please contact the NYS DEC before purchase, distribution, sale, or use. Some products may show a renewal date that has passed. These products are in the re-registration process and continue to be registered pending a re-registration decision. Information contained in the database is updated approximately every week.

Questions regarding this website should be directed to the [PMEP Webmaster](#).

8:49 PM 2/21/2015

The product labels are listed with different dates of acceptance by the NYS DEC

# Example: Mouse chickweed control

**DU PONT** DuPont™ Mesotrione 50WG herbicide

ACCEPTED FOR REGISTRATION

Doc id: 539802

Aug 29, 2014

GROUP 27 HERBICIDE

Active Ingredients  
Mesotrione: (CAS No. 104206-82-8) .....

Other Ingredients .....

EPA Reg. No. 352-842 EPA Est. 352-IL-001

New York State Department of Environmental Conservation  
Division of Materials Management  
Pesticide Product Registration

By Weight  
50.0%  
50.0%  
TOTAL 100.0%

**KEEP OUT OF REACH OF CHILDREN**  
**CAUTION**  
**FIRST AID**

**IF IN EYES:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.  
**IF ON SKIN OR CLOTHING:** Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.  
**IF INHALED:** Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.  
**IF SWALLOWED:** Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-441-3637 for emergency medical treatment information.

**PRECAUTIONARY STATEMENTS**  
**HAZARDS TO HUMANS AND DOMESTIC ANIMALS**  
**CAUTION.** Causes moderate eye irritation. Avoid contact with eyes or clothing.  
**PERSONAL PROTECTIVE EQUIPMENT (PPE)**

Refer to accompanying labeling for additional precautions and complete directions for use.

**Agricultural Use Requirements**  
Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. Refer to supplemental labeling under "Agricultural Use Requirements" in the Directions for Use section for information about this standard.

**STORAGE AND DISPOSAL**  
Do not contaminate water, food, or feed by storage or disposal.  
**PESTICIDE STORAGE:** Keep container tightly closed when not in use. Do not store near seed, fertilizers, or foodstuffs. Keep away from heat and flame.  
**PESTICIDE DISPOSAL:** Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.  
**Container Handling Refer to the Net Contents section of this product's labeling for the applicable "Nonrefillable Container" or "Refillable Container" designation.**  
**Nonrefillable Paper or Plastic Bags, Fiber Sacks including Flexible Intermediate Bulk Containers (FIBC) or Fiber Drums With Liners:** Nonrefillable container. Do not reuse or refill this container. Completely empty paper or plastic bag, fiber sack or drum liner by shaking and tapping sides and

The product label is provided as a pdf file for your use