

TEXAS A&M AGRILIFE

Herbicide Mode of Action: Limiting Weed Control Failure

—————→ **Scott Nolte**
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College Station TX

District 8 Webinar
12/14/2023

Topics to cover

Why we use herbicides

How herbicides work

Factors causing herbicide failure

Keep herbicides on target



What is a Weed?



- A plant growing out of place
- A plant interfering with human activities
- A plant whose negative characteristics outweigh its positive characteristics



Characteristics of Successful Weeds

Seedlings establish quickly under favorable conditions

Plants able to grow under conditions where most plants cannot

Produce a large number of seed

Able to reproduce vegetatively through stolons/rhizomes

Seed remain viable after long periods of dormancy

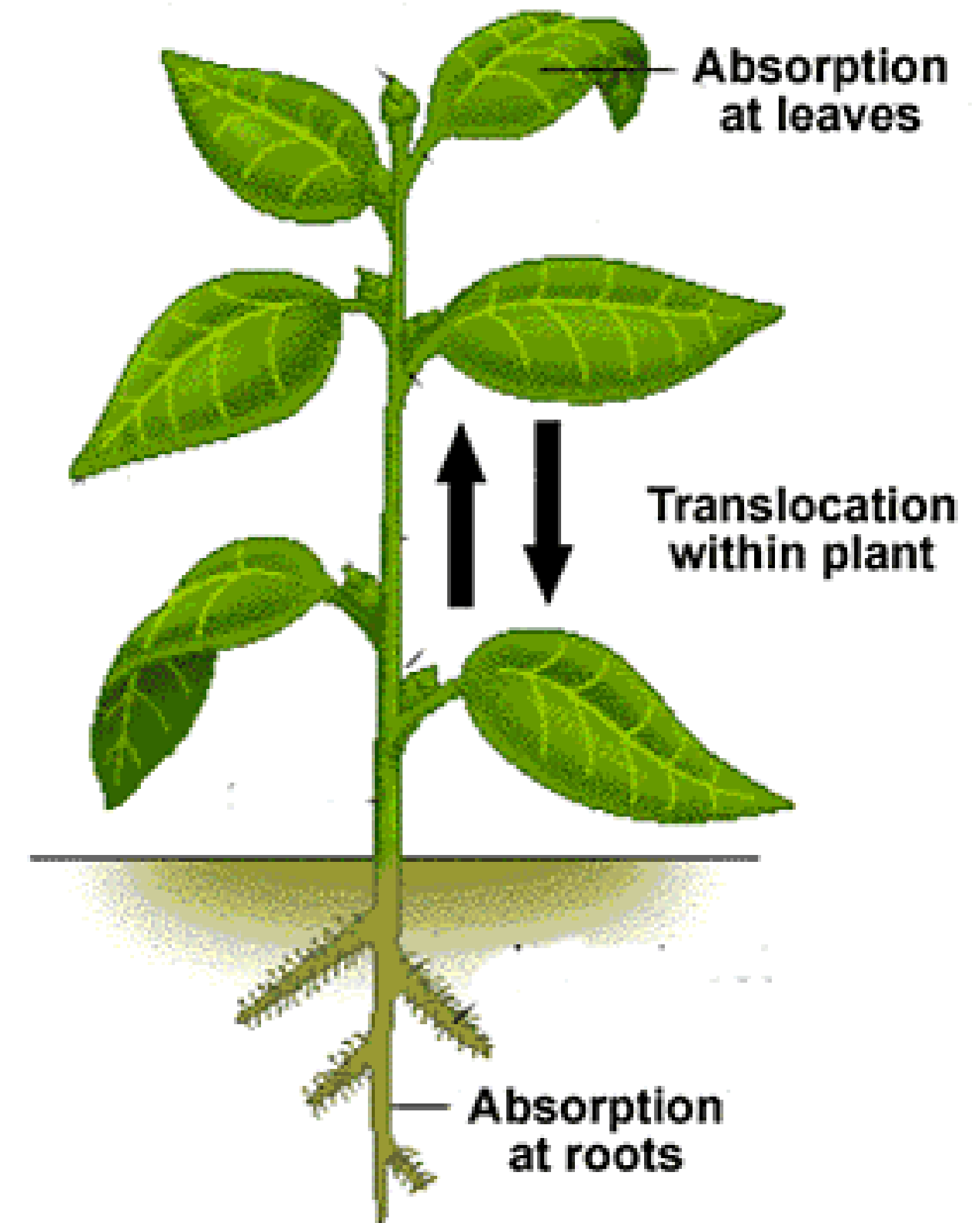
Seed with specialized structures for transport

Allelopathy

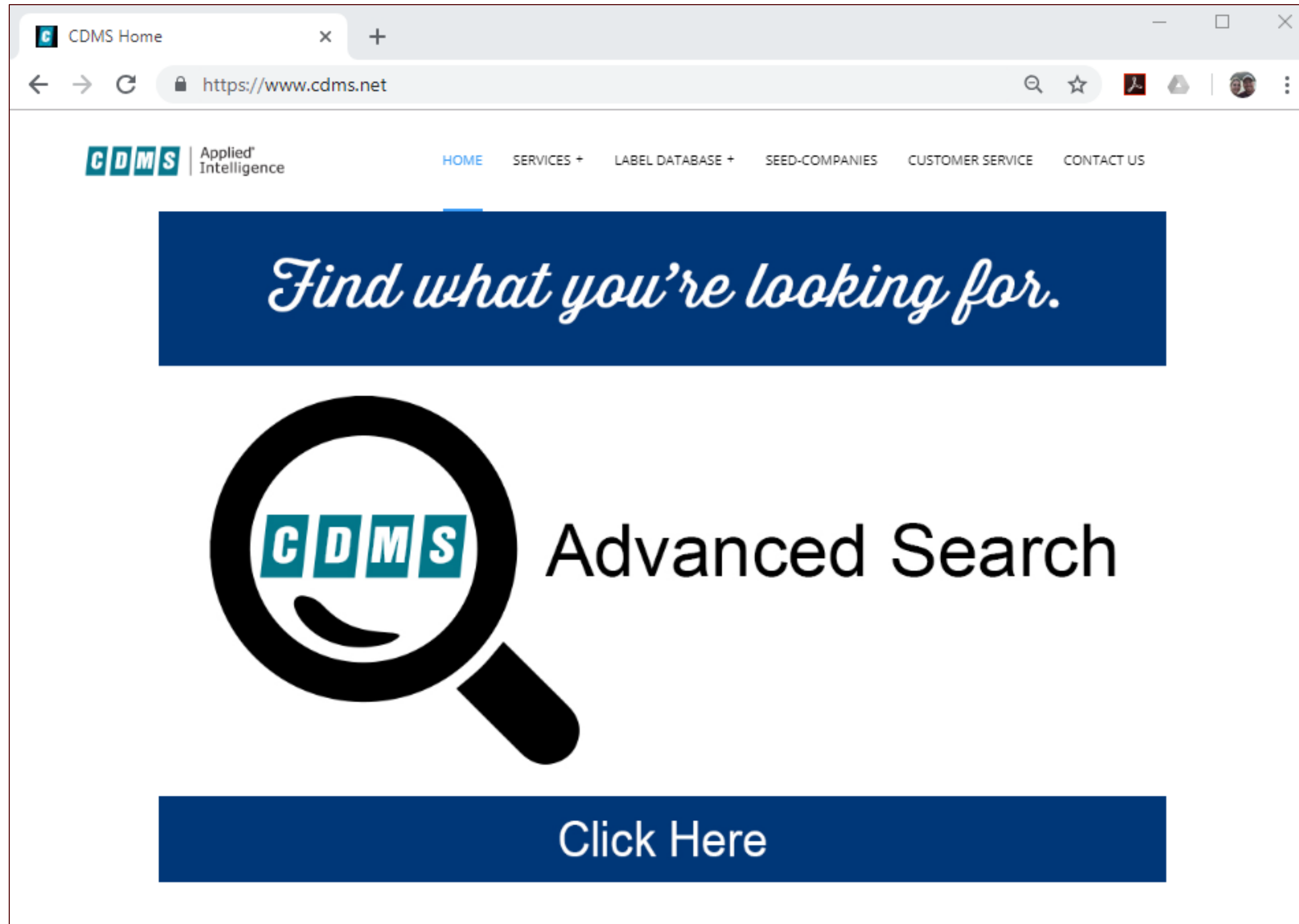
Herbicide Basics and Terminology

Herbicide Efficacy

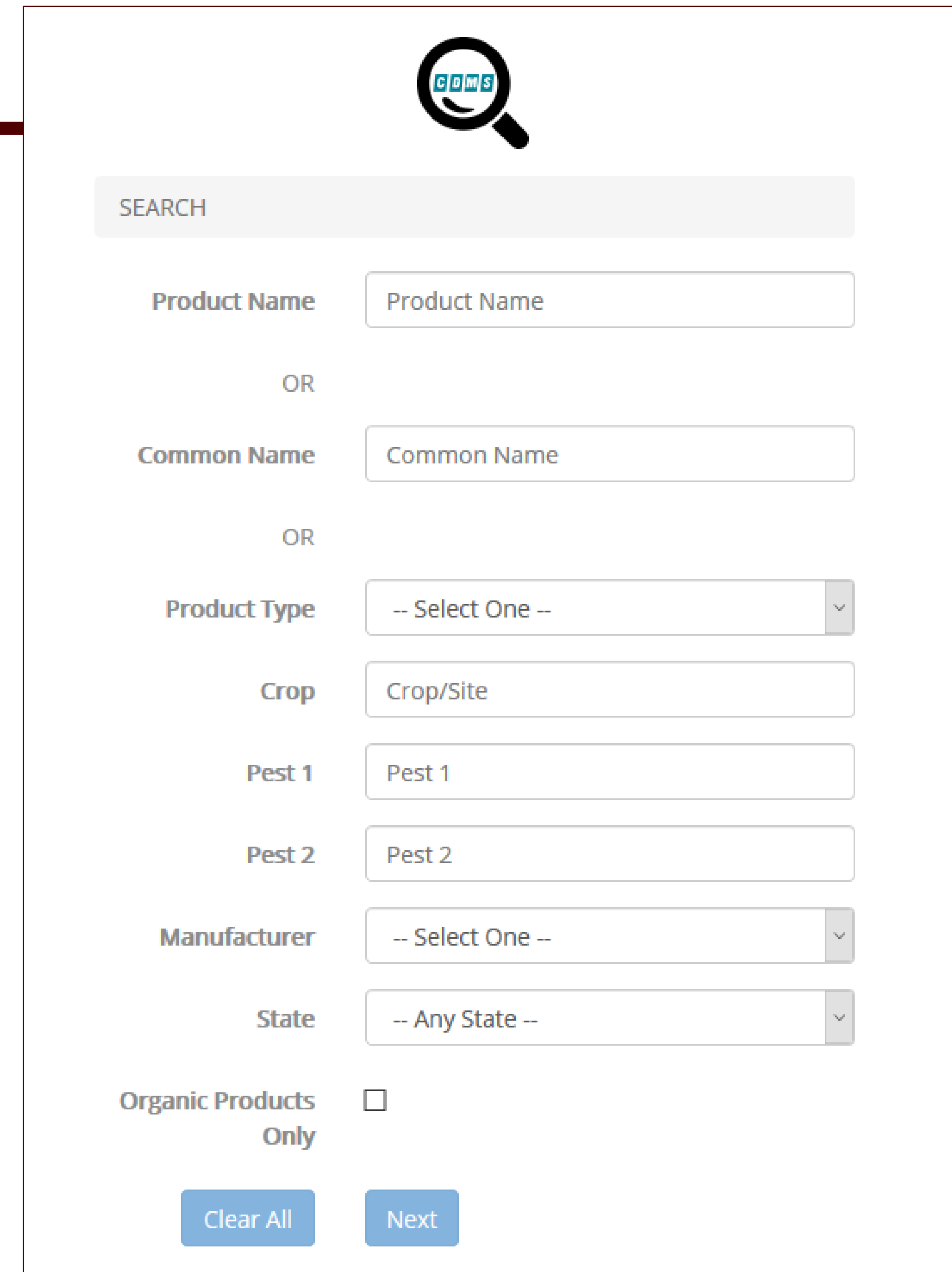
- Active ingredient – the chemical that is toxic within the plant
- For herbicides to be effective inside the weed, they must:
 - Be sprayed at a toxic concentration (rate)
 - Be taken up by either roots or leaves (absorption)
 - Be moved to their site of toxicity (translocation)
 - Contact – short distance
 - Systemic – long distance
 - Not be broken down or removed prior to reaching their target site



www.cdms.net



The screenshot shows a web browser window with the address bar displaying "https://www.cdms.net". The website header includes the CDMS logo and navigation links: HOME, SERVICES +, LABEL DATABASE +, SEED-COMPANIES, CUSTOMER SERVICE, and CONTACT US. A large blue banner contains the text "Find what you're looking for." Below this is a magnifying glass icon with the CDMS logo inside it, followed by the text "Advanced Search". At the bottom of the banner is a blue button labeled "Click Here".



This image shows a detailed view of the search form. At the top right is a magnifying glass icon with the CDMS logo. Below it is a search bar labeled "SEARCH". The form contains several input fields and dropdown menus:

- Product Name**: Input field with placeholder text "Product Name".
- OR**: Text separator.
- Common Name**: Input field with placeholder text "Common Name".
- OR**: Text separator.
- Product Type**: Dropdown menu with "-- Select One --".
- Crop**: Input field with placeholder text "Crop/Site".
- Pest 1**: Input field with placeholder text "Pest 1".
- Pest 2**: Input field with placeholder text "Pest 2".
- Manufacturer**: Dropdown menu with "-- Select One --".
- State**: Dropdown menu with "-- Any State --".
- Organic Products Only**: A checkbox that is currently unchecked.

At the bottom of the form are two buttons: "Clear All" and "Next".

<https://greenbook.net>

Greenbook

greenbook.net

Amazon Smile SSO Texas A&M AgriLif... Texas Data Weather Forecast... My Meetings - Zo... Interfolio Mint

greenbook Category Lists

Plant Protection Label Data.

Search Over 10,000 chemical product labels

All Search by label, pest, product type, manufacturer, crop, ingredient... **Q**

Advanced Search

Powered by **AGWORLD**

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What is “Mode of Action?”

- How the active ingredient disrupts plant growth
- Identified by outward symptoms
- Indicated on the label by the Group number
- The herbicide is toxic at a specific location known as the “Site Of Action” or target site – more precise

ATTENTION:
This specimen label is provided for general information only.

- This pesticide product may not yet be available or approved for sale or use in your area.
- It is your responsibility to follow all Federal, state and local laws and regulations regarding the use of pesticides.
- Before using any pesticide, be sure the intended use is approved in your state or locality.
- Your state or locality may require additional precautions and instructions for use of this product that are not included here.
- Monsanto does not guarantee the completeness or accuracy of this specimen label. The information found in this label may differ from the information found on the product label. You must have the EPA approved labeling with you at the time of use and must read and follow all label directions.
- You should not base any use of a similar product on the precautions, instructions for use or other information you find here.
- Always follow the precautions and instructions for use on the label of the pesticide you are using.

2113613-48



Roundup PRO
Herbicide

The complete broad-spectrum postemergence professional herbicide for industrial, turf and ornamental weed control.

Complete Directions for Use

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION IS LIKELY TO RESULT.

EPA Reg. No. 524-475 2010-1

GROUP	9	HERBICIDE
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Read the entire label before using this product.
Use only according to label instructions.
Not all products listed on this label are registered for use in California. Check the registration status of each product in California before using.
Read the “LIMIT OF WARRANTY AND LIABILITY” statement at the end of the label before buying or using. If terms are not acceptable, return at once unopened.
THIS IS AN END-USE PRODUCT. MONSANTO DOES NOT INTEND AND HAS NOT REGISTERED IT FOR REFORMULATION. SEE INDIVIDUAL CONTAINER LABEL FOR REPACKAGING LIMITATIONS.

1.0 INGREDIENTS

ACTIVE INGREDIENT

*Glyphosate, N (phosphonemethyl)glycine, in the form of its isopropylamine salt	41.0%
OTHER INGREDIENTS (including surfactant).....	59.0%
	100.0%

*Contains 480 grams per liter or 4 pounds per U.S. gallon of the active ingredient glyphosate, in the form of its isopropylamine salt. Equivalent to 356 grams per liter or 3 pounds per U.S. gallon of the acid, glyphosate.

This product is protected by U.S. Patent Nos. 5,683,958; 5,703,015; 6,063,733; 6,121,199; 6,121,200. No license granted under any non-U.S. patent(s).

2.0 IMPORTANT PHONE NUMBERS

FOR PRODUCT INFORMATION OR ASSISTANCE IN USING THIS PRODUCT, CALL TOLL-FREE, 1-800-332-3111.
IN CASE OF AN EMERGENCY INVOLVING THIS PRODUCT, OR FOR MEDICAL ASSISTANCE, CALL COLLECT, DAY OR NIGHT, (314) 694-4000.

3.0 PRECAUTIONARY STATEMENTS

3.1 Hazards to Humans and Domestic Animals

Keep out of reach of children.
CAUTION!
CAUSES EYE IRRITATION.
Avoid contact with eyes or clothing.

FIRST AID: Call a poison control center or doctor for treatment advice.	
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.

- Have the product container or label with you when calling a poison control center or doctor, or going for treatment.
- You may also contact (314) 694-4000, collect day or night, for emergency medical treatment information.
- This product is identified as Roundup PRO® herbicide, EPA Registration No. 524-475.

DOMESTIC ANIMALS: This product is considered to be relatively non-toxic to dogs and other domestic animals; however, ingestion of this product or large amounts of freshly sprayed vegetation may result in temporary gastrointestinal irritation (vomiting, diarrhea, colic, etc.). If such symptoms are observed, provide the animal with plenty of fluids to prevent dehydration. Call a veterinarian if symptoms persist for more than 24 hours.

Personal Protective Equipment (PPE)
Applicators and other handlers must wear: long-sleeved shirt and long pants, shoes plus socks. Follow manufacturer's instructions for cleaning/maintaining Personal Protective Equipment (PPE). If there are no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.
Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them.

When handlers use closed systems, enclosed cabs or aircraft in a manner that meets the requirements listed in Worker Protection Standard (WPS) for agricultural pesticides (40 CFR 170.240 (d) (4-6)), the handler PPE requirements may be reduced or modified as specified in the WPS.

IMPORTANT: When reduced PPE is worn because a closed system is being used, handlers must be provided all PPE specified above for "applicators and other handlers" and have such PPE immediately available for use in an emergency, such as spill or equipment breakdown.

User Safety Recommendations

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

3.2 Environmental Hazards

Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters.

3.3 Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied using only stainless steel, aluminum, fiberglass, plastic or plastic-lined steel containers.
DO NOT MIX, STORE OR APPLY THIS PRODUCT OR SPRAY SOLUTIONS OF THIS PRODUCT IN GALVANIZED STEEL OR UNLINED STEEL (EXCEPT STAINLESS STEEL) CONTAINERS OR SPRAY TANKS. This product or spray solutions of this product react with such containers and tanks to produce hydrogen gas which may form a highly combustible gas mixture.

Why Does Weed Control Fail?



Misidentification

Equipment

Rate and weed size

Soil Conditions

Climatic Conditions

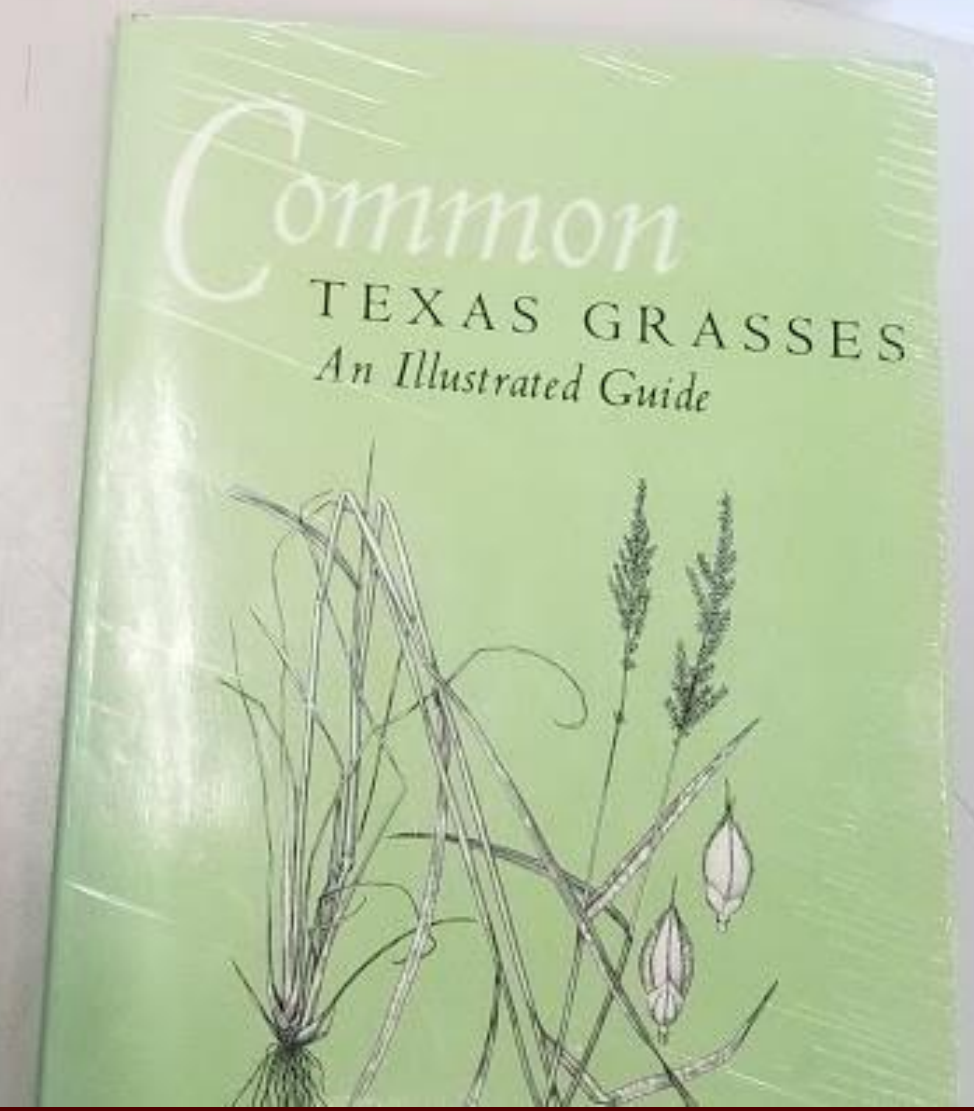
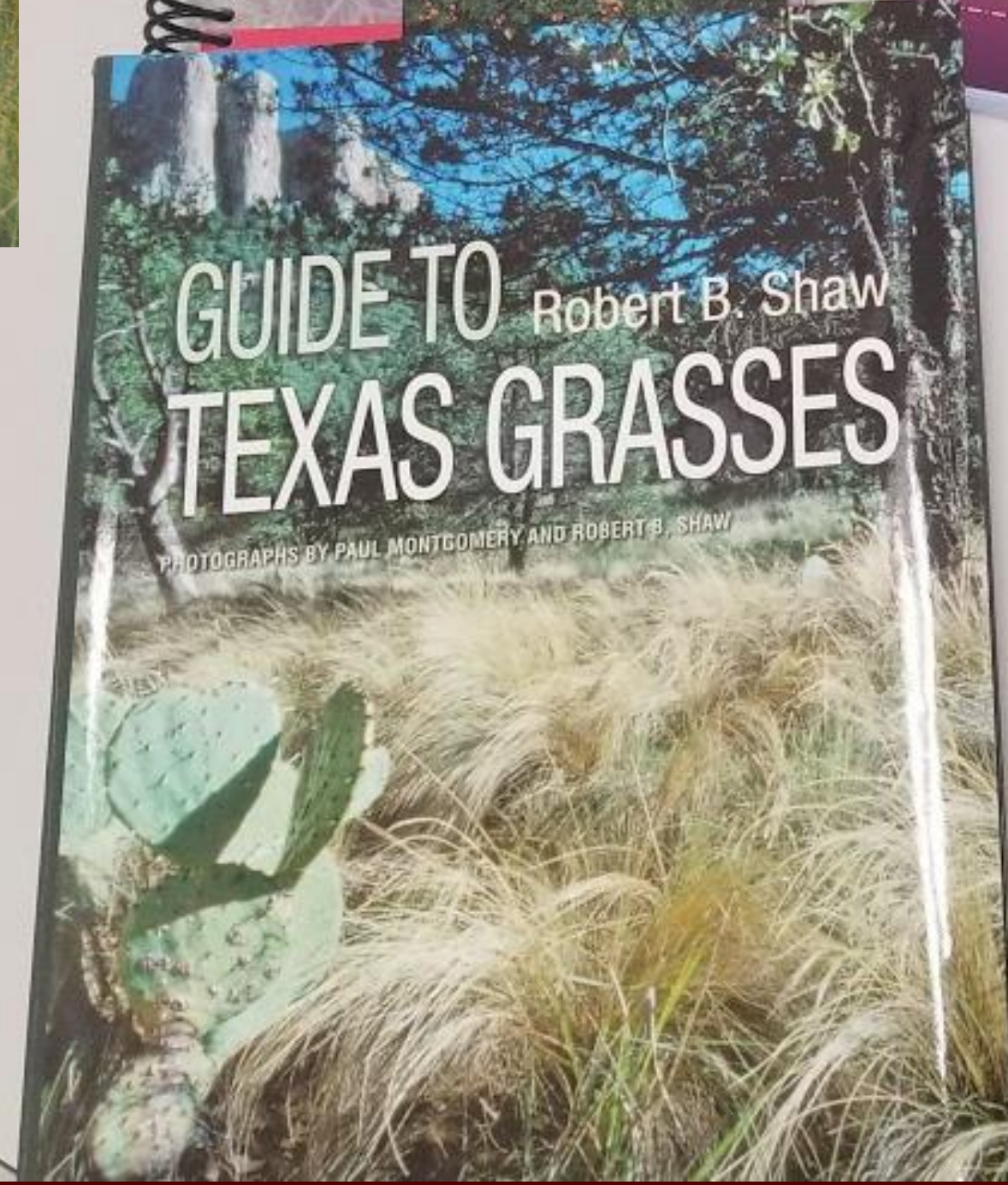
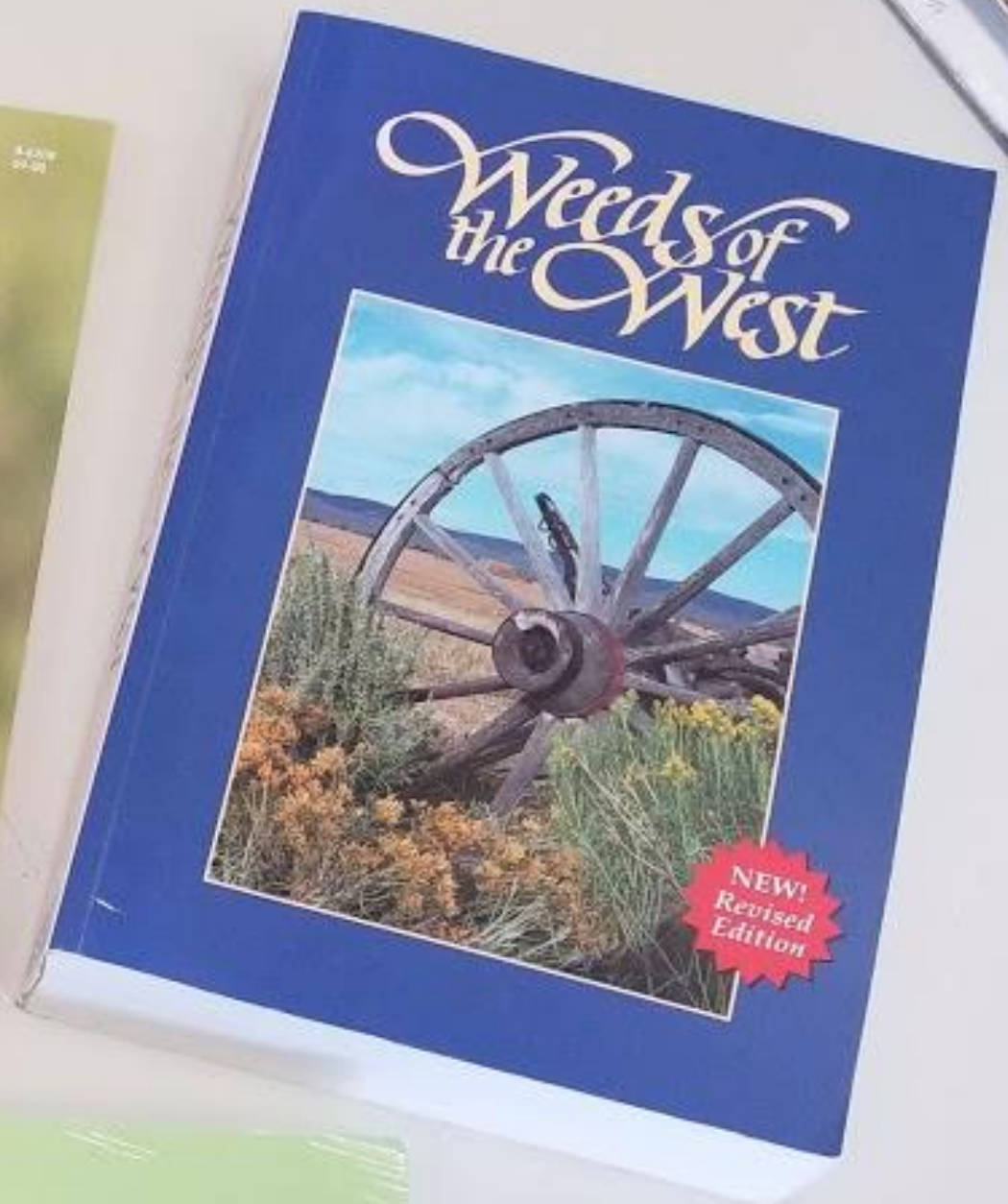
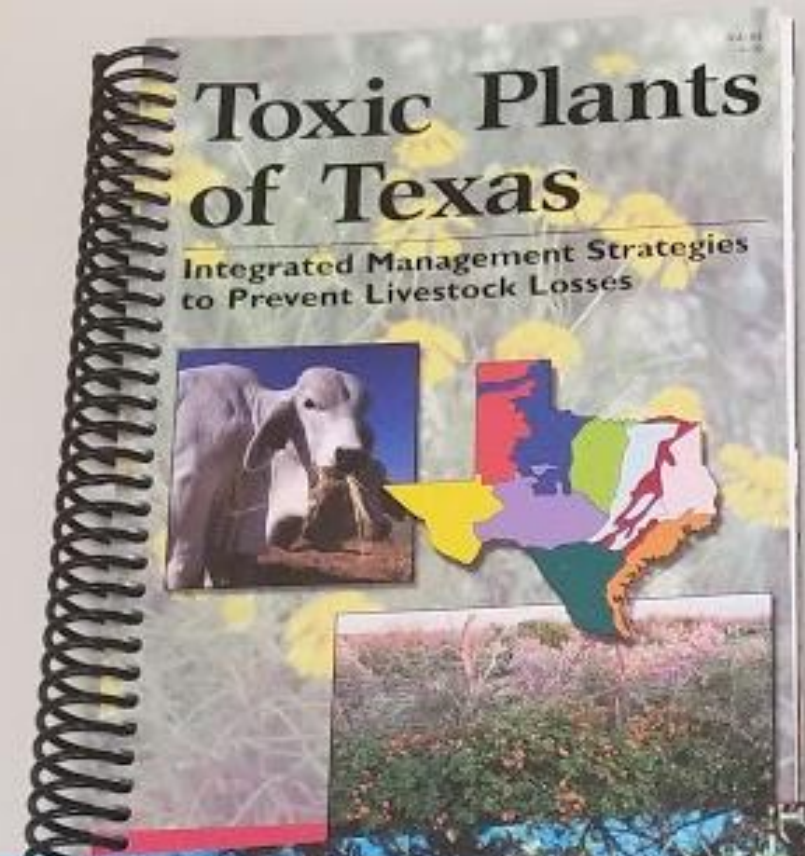
Weed Factors

Resistance





Misidentification



ID Resources



AgriLIFE EXTENSION
Texas A&M System

Plants of Texas Rangelands

Virtual Herbarium

Department of
ECOSYSTEM SCIENCE AND MANAGEMENT

Home Virtual Herbarium Publications



Cholla
Opuntia imbricata (Haw.) DC

Successful rangeland management plans begin with proper plant identification.

This website provides a description, identifying characteristics, the geographic distribution and a habitat description of species found on Texas rangelands, along with photographs of the plant and its distinguishing features. Information on the most common toxic plants in the state, including signs of poisoning and controlling these plants are also included.

Help Me Identify My Plant

Common Name Index Scientific Name Index

Map of Regions Plants In Our Books

Browse Our Collections

AquaPlant

A Diagnostics Tool for Pond Plants and Algae

[HOME](#) [FIND A PLANT](#) [DO I NEED A PERMIT?](#) [COMMON QUESTIONS](#) [GLOSSARY](#) [VIDEOS](#) [GET HELP](#)

The AquaPlant site is designed to help land owners identify and manage plants in their ponds or tanks. To best manage your pond vegetation, start by using the Identify a Plant section to correctly identify the plants in your pond, and then select the best management options to fit your needs for specific plants from the Manage a Plant section. Whether you choose to use a herbicide, biological control, or to remove plants manually, this site can help.

Identify a Plant



If you don't know the name of your plant, start here to compare photos and identify what type of plant is in your pond.

Manage a Plant



If you already know the name of the plant in your pond, start here to browse by name and find management options.

Fish Stocking & Pond Management



SEARCH FOR A TYPE OF PLANT

Search

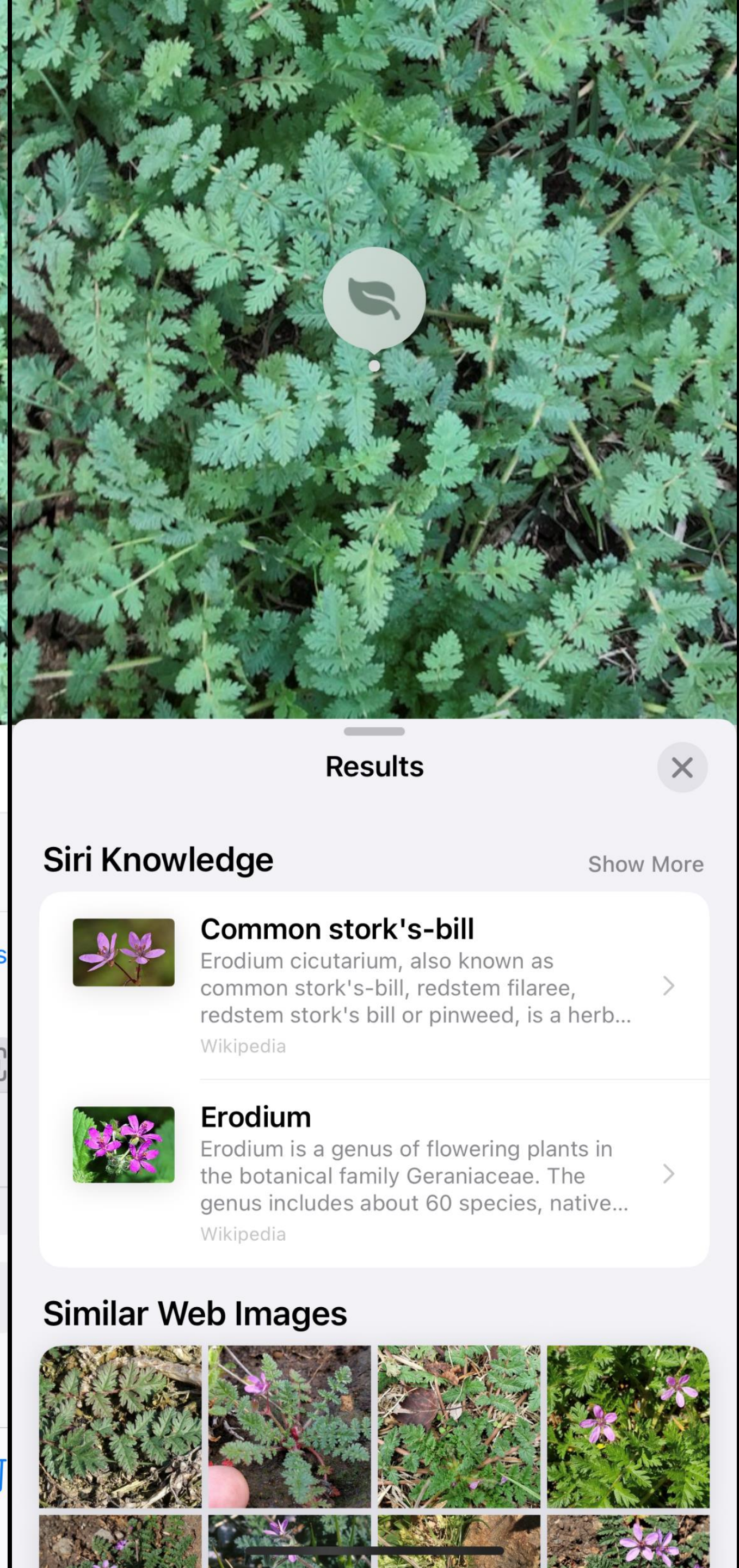
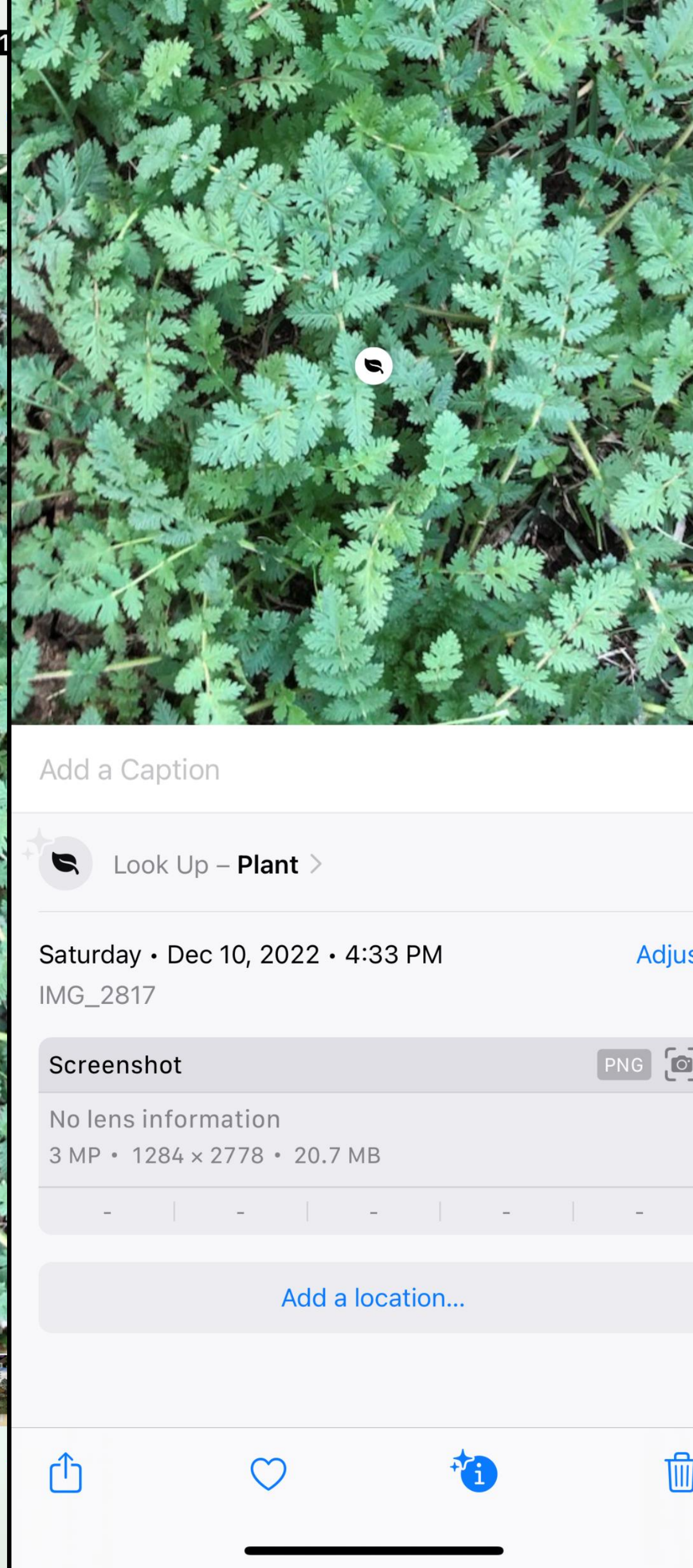
[Download Management Apps](#)

[Hire a Professional](#)

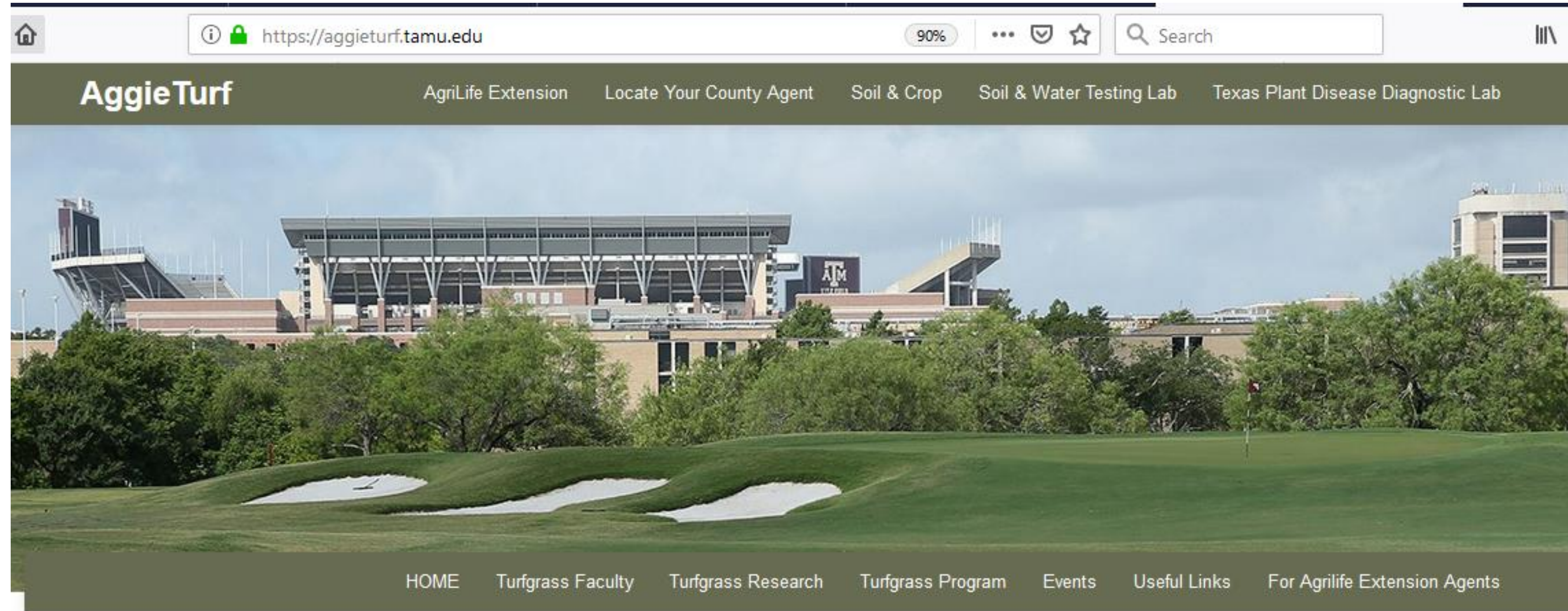
[Contact Your Ag & Natural Resource Agent](#)

[Permissions and Citations](#)

[Aquatic Herbicide Tables](#)



aggieturf.tamu.edu



Recent Posts

New AgriLife Extension specialist touts turfgrass practices for environmental, human health August 7, 2018

New statewide turfgrass specialist joins TAMU Soil and Crop Sciences faculty August 7, 2018

Information Pages

- Texas Turfgrasses
- Turfgrass Weeds
- Turfgrass Insects
- Glossary
- Publications

Howdy! Welcome to the AggieTurf website!

Aggieturf.tamu.edu has been designed to provide information on Texas turfgrasses and the role they play in the lives of millions of Texans. Turfgrasses often serve as the backbone for residential and commercial landscapes, athletic fields, recreational areas, and golf courses while also playing a vital role in the Texas Green Industry.

AggieTurf is designed to be a comprehensive site for Texas turfgrasses, selection & management considerations, pest control (weeds, insects, & diseases), links to Texas A&M AgriLife Extension content, and other useful information.

Update (8/28/2018): Our website will be undergoing gradual renovations including a change to the overall look and feel, as well as added content. Sign-up to receive updates as we continue to develop new content and information for you!

Sign up for updates!

Get updates from AggieTurf to your inbox



Recent Posts

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Turfgrass Weeds

Weeds of Texas Turf

Casey Reynolds, PhD and Matt Elmore, PhD



Not seeing what you are looking for? Use [this](#) document when preparing samples or photographing weeds for identification purposes.

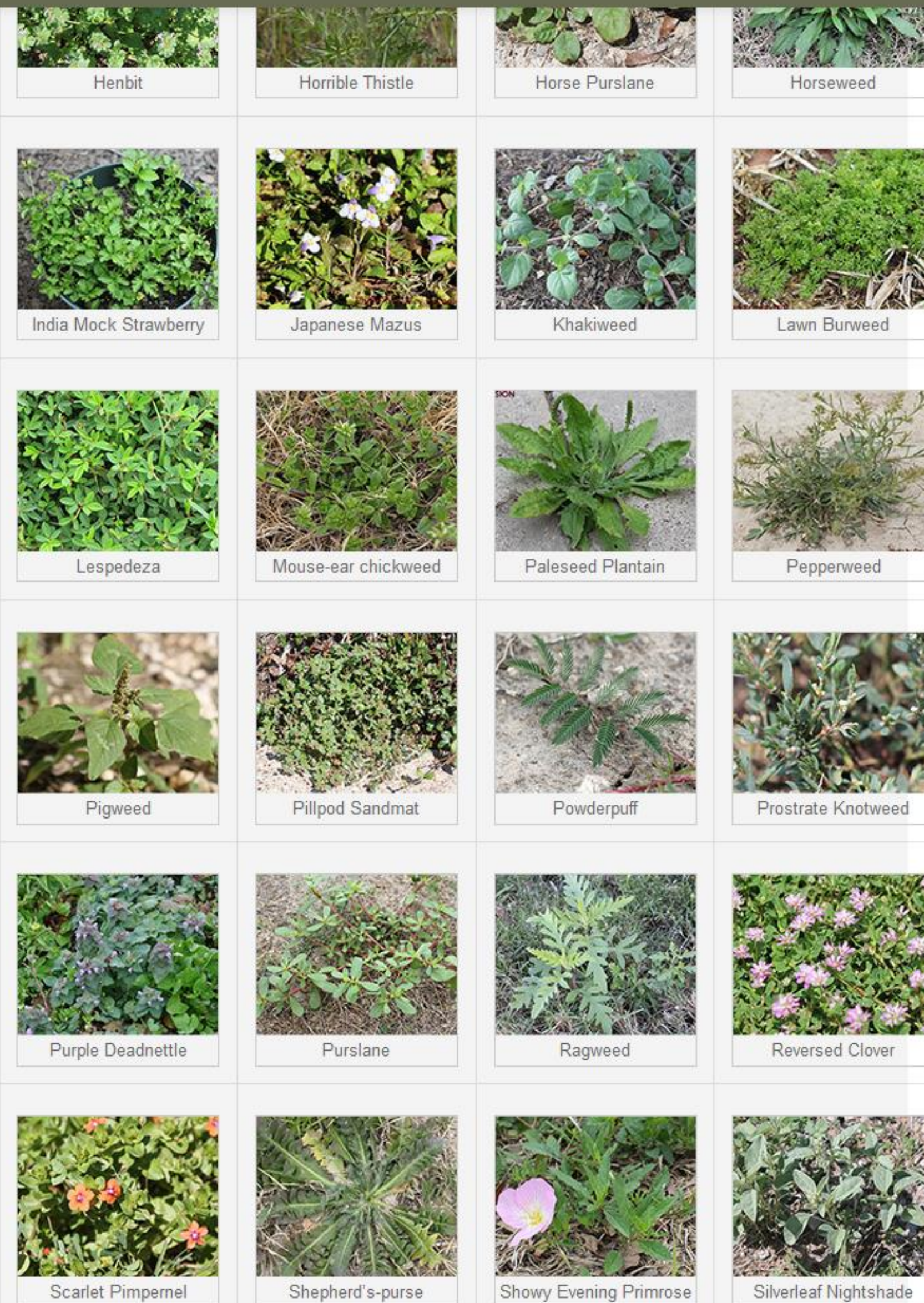
Weed Identification

Weeds, like all plants, are classified based on morphological characteristics of their vegetative and reproductive structures. A basic understanding of the types of weeds commonly found in turf is very helpful in identification and herbicide selection.

Weeds are often grouped by morphological characteristics into the categories: *broadleaf weeds*, *grassy weeds*, and *sedges* (Table 1).

Table 1. General Characteristics of Weed Species When Grouped as Broadleaf weeds, Grassy Weeds, or Sedges.

	Broadleaf Weeds	Grasses and Grass-like Weeds	Sedges
Embryo	Dicot	Monocot	Monocot
Stem	Usually solid, variable in shape	Hollow, round or flattened	Solid, usually triangular
Leaf Shape	Variable	Simple, entire	Simple, entire
Leaf Arrangement	Variable	Alternate, opposite	Alternate, opposite



Henbit

Horrible Thistle

Horse Purslane

Horseweed

India Mock Strawberry

Japanese Mazus

Khakiweed

Lawn Burweed

Lespedeza

Mouse-ear chickweed

Paleseed Plantain

Pepperweed

Pigweed

Pillpod Sandmat

Powderpuff

Prostrate Knotweed

Purple Deadnettle

Purslane

Ragweed

Reversed Clover

Scarlet Pimpernel

Shepherd's-purse

Showy Evening Primrose

Silverleaf Nightshade

Positive Weed Identification



Rulers



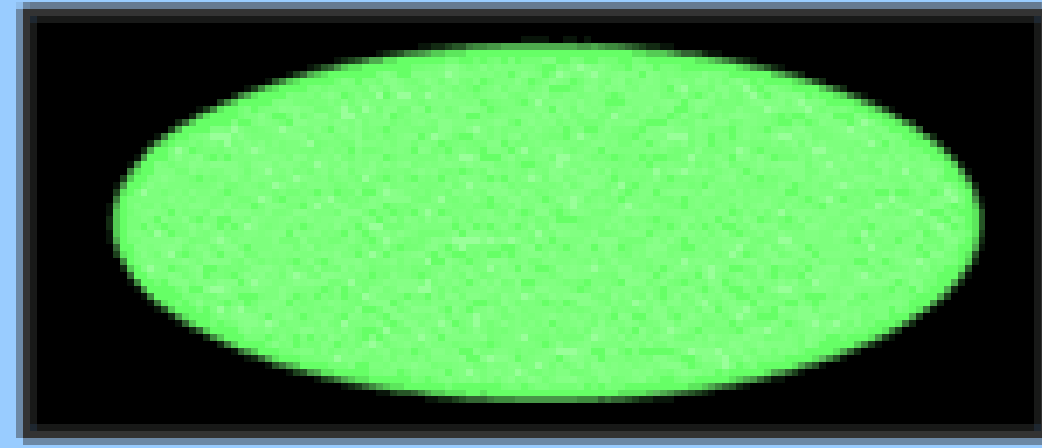
Hand Lens



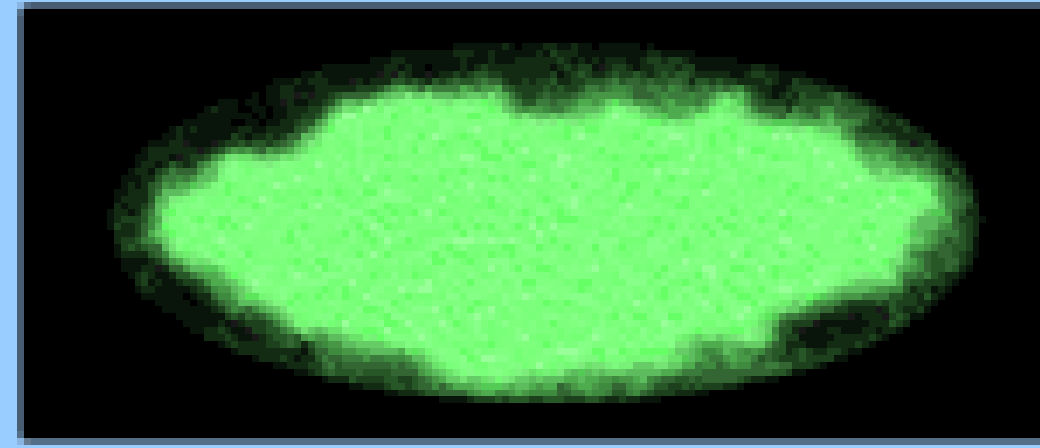
- Determines proper control recommendations
- Impacts cost of control

- Photos need to show detail
- Use a matte black background
- Include information about the area where the weeds are growing

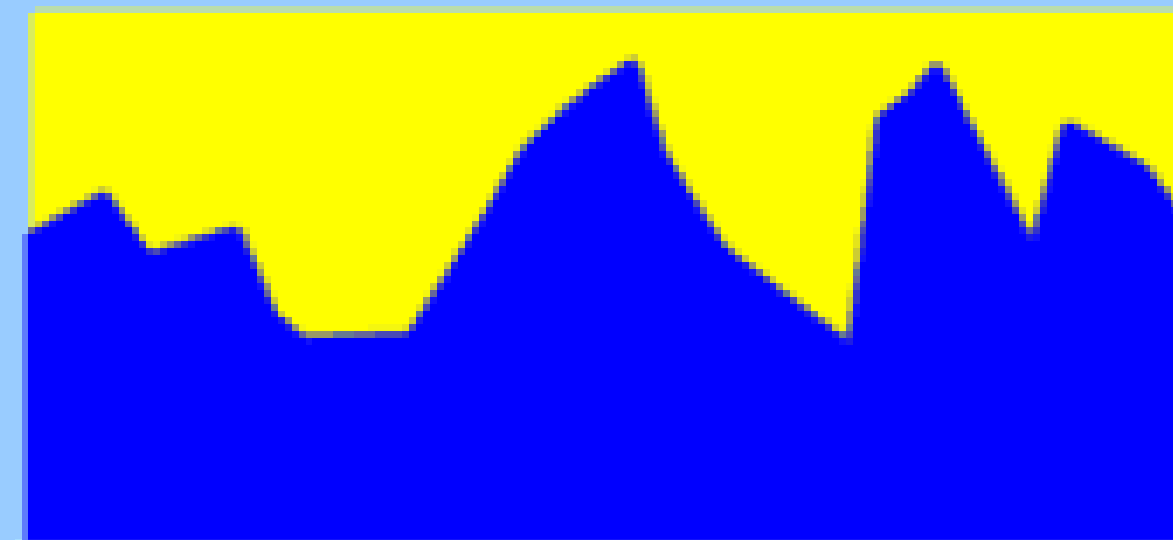
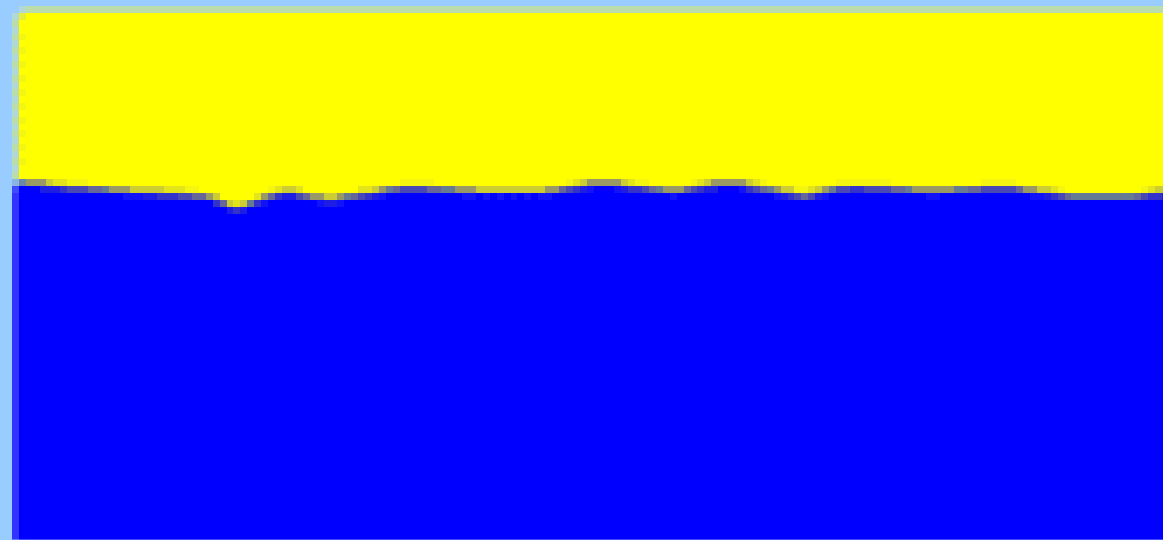
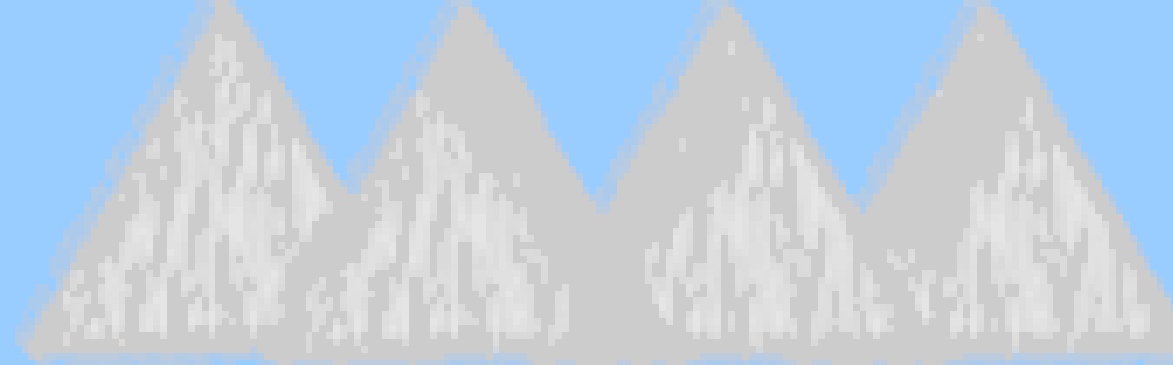
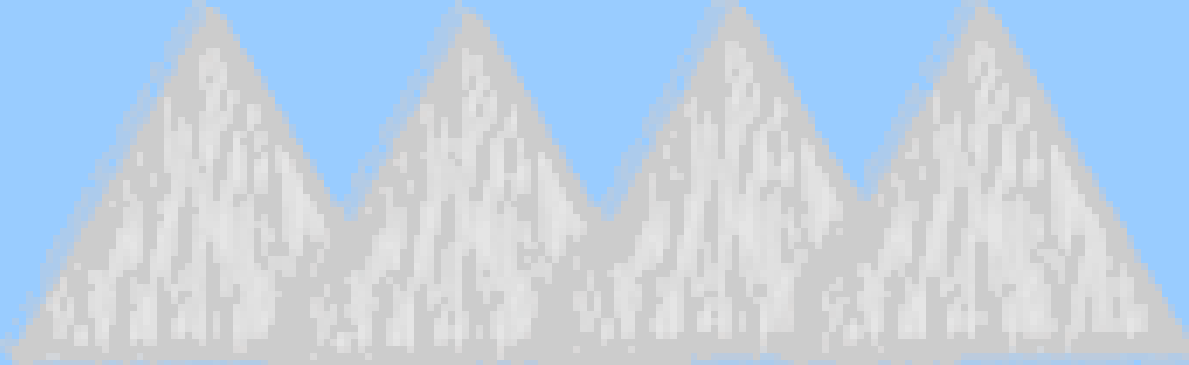
Equipment Issues



New



Damaged



- Clogged or damaged tips result in an inconsistent spray pattern
- Poor agitation prevents a uniform herbicide application
- Boom not set at correct height may result in improper weed coverage





Incorrect Rate and Weed Size

Incorrect rate to control target species, Incorrect calculations
Lowering the rate below the manufacturer's recommendation
Application to weeds larger than label recommends may result in unacceptable control

- Contact herbicides are more effective on smaller weeds



Why Calibrate?





Calibration

“the dose makes the poison”

- Too little and weeds will not be affected
- Too much and desirable plants may suffer

When broadcast-applying herbicides – the “dose” is dependent upon application speed, sprayer output, and the amount of herbicide in solution

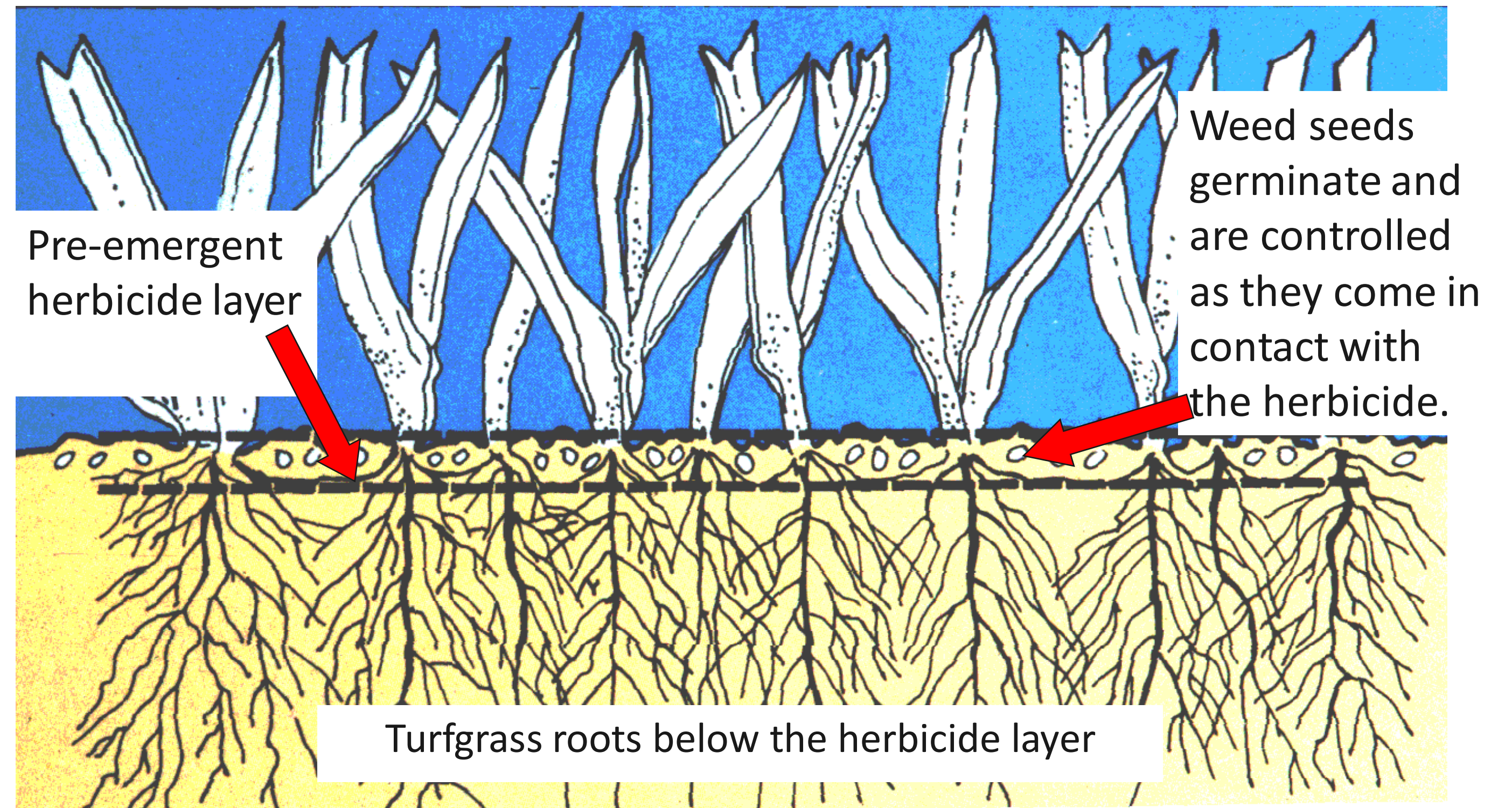
Soil Conditions



Most common for preemergent or preplant herbicide applications

Herbicide must be moved to weed seed zone by

- Incorporation
- Rainfall
- Irrigation



Preemergence herbicides do not prevent weed seeds from germinating.

Soil Conditions



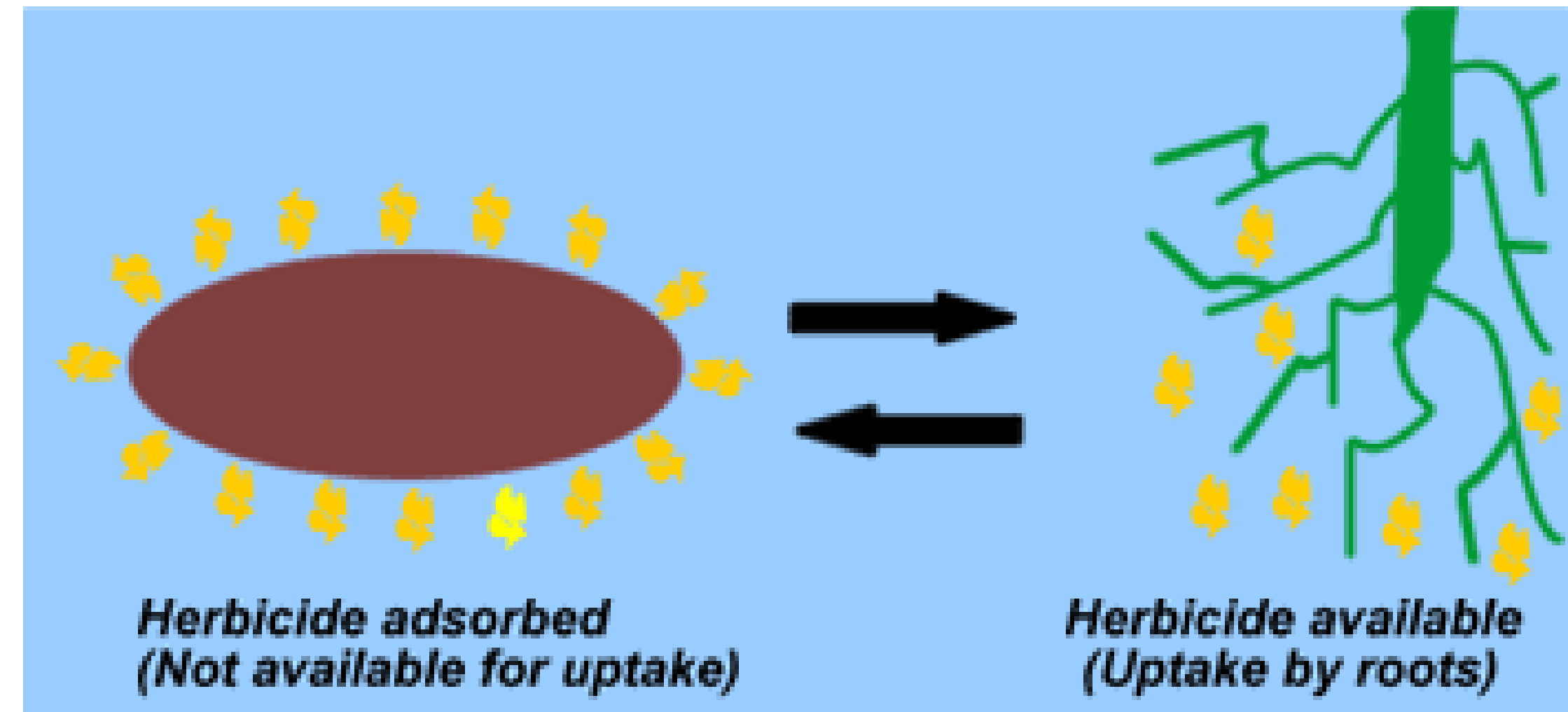
Inadequate soil moisture

- Poor activation and uptake of the herbicide

Adsorption to soil

- Herbicide bound to soil or trash on surface
- Renders herbicide inactive

Rough soil surface creates uneven herbicide distribution



Climatic Conditions



Herbicide washed off by rainfall, unable to be taken up by weed

Improper temperature at time of application can reduce herbicide effectiveness

- Too high
- Too low

Low humidity dries herbicide solution before it can be absorbed by plant



Climatic Conditions



Poor growing conditions such as prolonged periods of dry/hot or cold/wet weather can result in stressed weeds

Stressed weeds are not actively growing

Herbicides are absorbed and translocated when the plant is actively growing

Stressful growing conditions often result in poor herbicide performance

Dry vs Good Growing Conditions

Green Flatsedge Study



2006 [†] - Good Growing Conditions			
Treatment	Rate/Acre	32 DAT	93 DAT
WeedMaster	2 QT	78	92
2016 [‡] - Dry Growing Conditions			
Treatment	Rate/Acre	31 DAT	88 DAT
WeedMaster	2 QT	62.5	57.5

34% Lower Control

[†]Applied: 6-7-06; 15 GPA; 36" green flatsedge
[‡]Applied: 7-22-16; 15 GPA; 30" green flatsedge

Weed Factors



Dense stands of weeds

Prevents complete coverage into the weed canopy

Can result in poor coverage on smaller weeds & inadequate control

Increase your GPA of carrier



Weed Factors



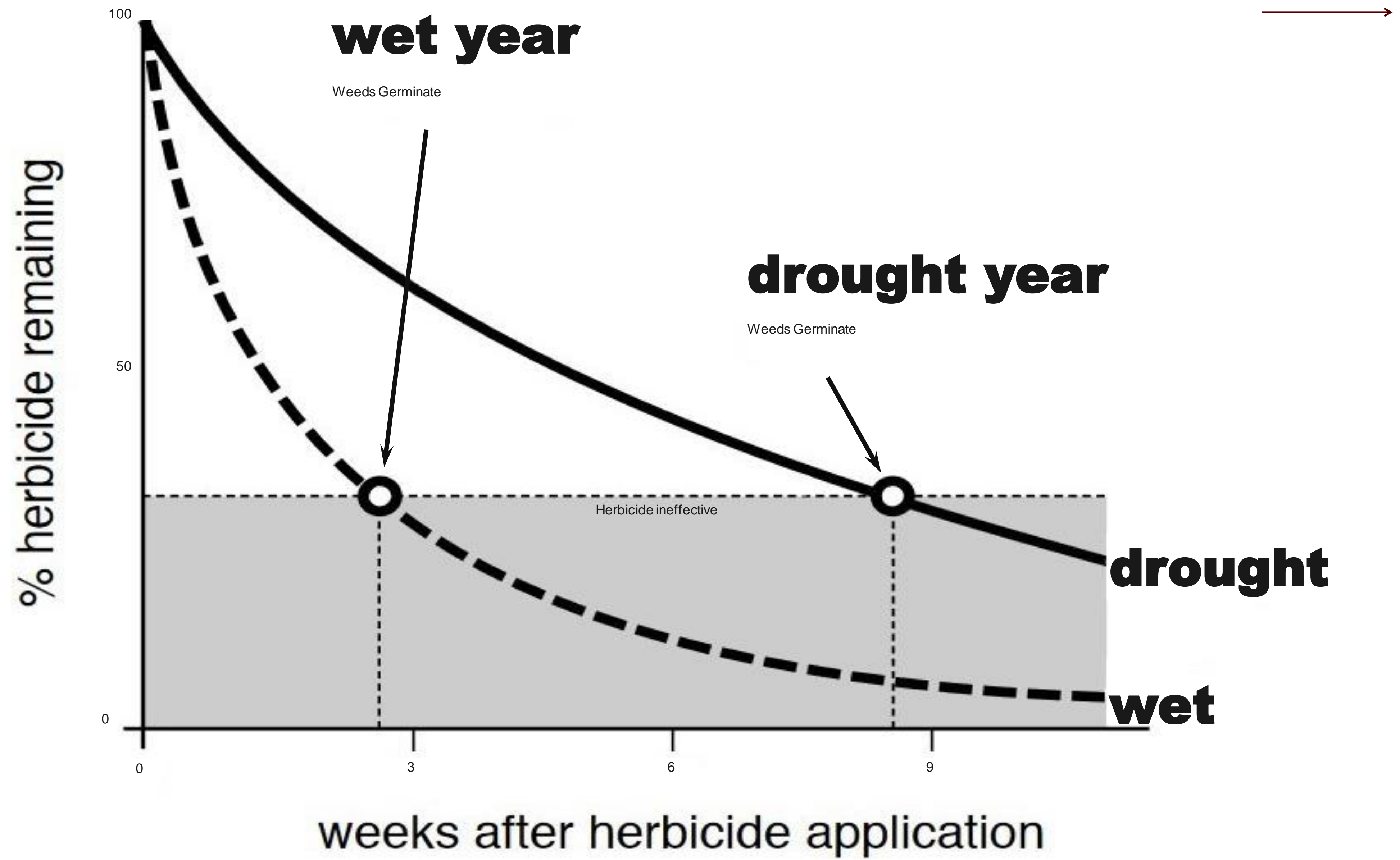
New weed flush after initial herbicide application

- may appear to be herbicide failure
- Soil seed bank, can persist for many years
- Most seed (>70%) germinate within 4 years

Soil residual herbicide runs out

- Herbicide fate
- Impacted by environmental conditions





Resistance



- Inherited ability of a weed to withstand a previously effective herbicide at its labeled rate
- Due to a naturally occurring genetic change
- Becomes apparent through selection pressure by a herbicide
- Herbicides DO NOT cause genetic changes in individual weeds to make them become resistant



Off-Target Movement

Why is staying on target important?

More consistent control

Good Stewardship

– Product Longevity

– Herbicide Resistance Management

Reduce application cost

Neighboring crop damage

Public perception

EPA Requirement

TEXAS A&M
AGRI LIFE
EXTENSION

SCS-2018-11

General Information About Glyphosate

Scott Nolte-Texas A&M AgriLife Extension; Peter Dotray-Texas A&M AgriLife Research & Extension;
Muthu Bagavathiannan-Texas A&M AgriLife Research

What is glyphosate

Glyphosate is an herbicide used to control a wide range of undesirable plants in lawns and gardens, row crops, pastures, aquatics, road sides, rights-of-way, and other managed areas. First introduced for use in 1974, glyphosate is now one of the most widely used herbicides in the United States. Today, there are over 750 products that contain this active ingredient for agronomic, commercial, and home use.

How does it work

Glyphosate kills a wide range of annual and perennial plants (grasses, broadleaves, and sedges) by preventing them from making 3 essential aromatic amino acids. It does this by inhibiting a specific enzyme, EPSP synthase, only found in plants and many bacteria.

Is it likely that glyphosate can cause cancer

Regulatory agencies charged with the risk assessment of substances and their impact to the public including Health Canada, European Food Safety Authority (EFSA), Food and Agriculture Organization (FAO) of the United Nations, World Health Organization (WHO), and the United States Environmental Protection Agency (US-EPA), all released findings of their assessments later in 2015, 2016 and 2018. Based on the most currently available research, these agencies have all concluded that glyphosate was unlikely to pose a carcinogenic risk to humans.



Off-Target Movement Reducing your risk

Wind speed of 3-15mph

–Gusting?

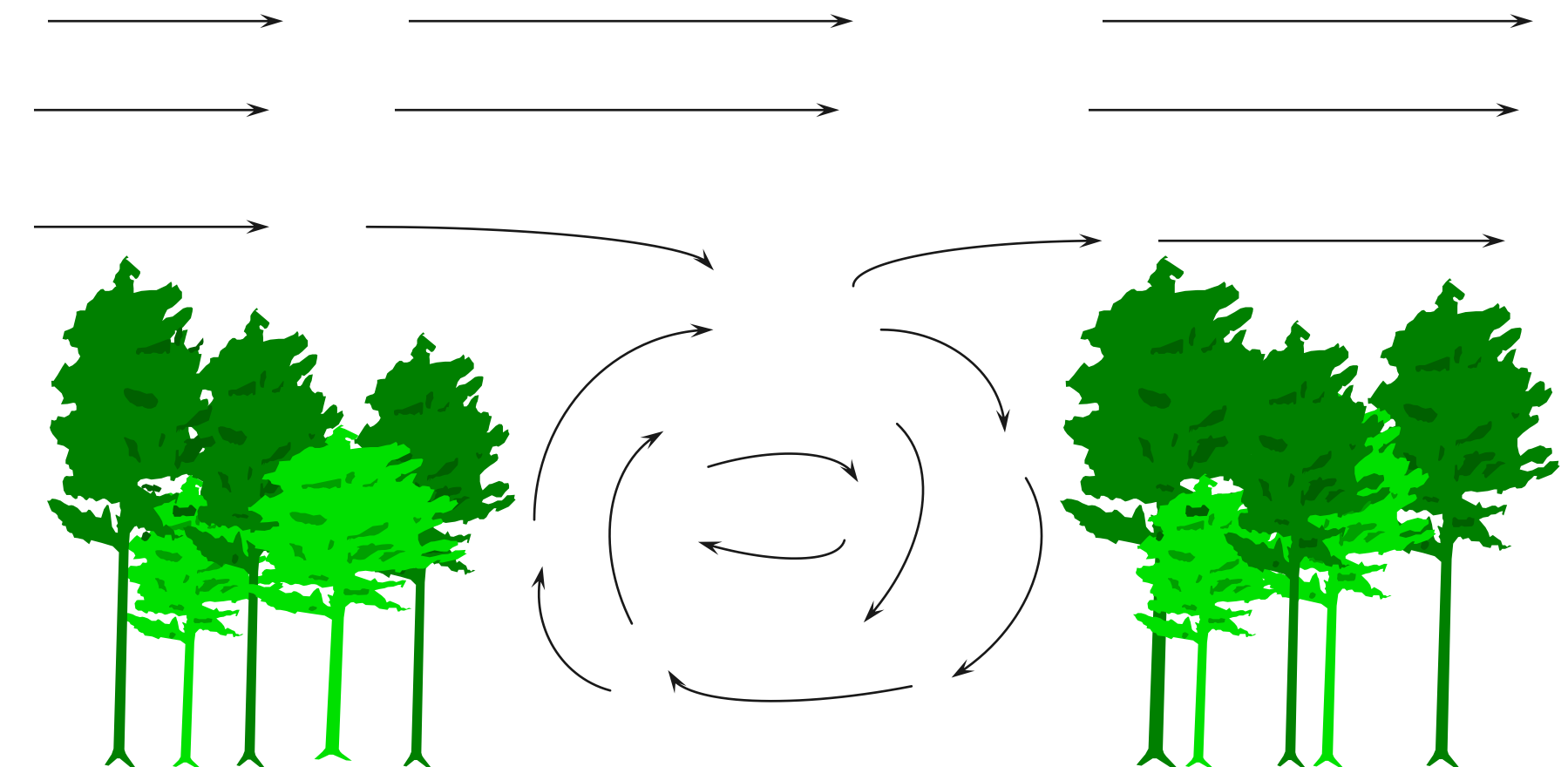
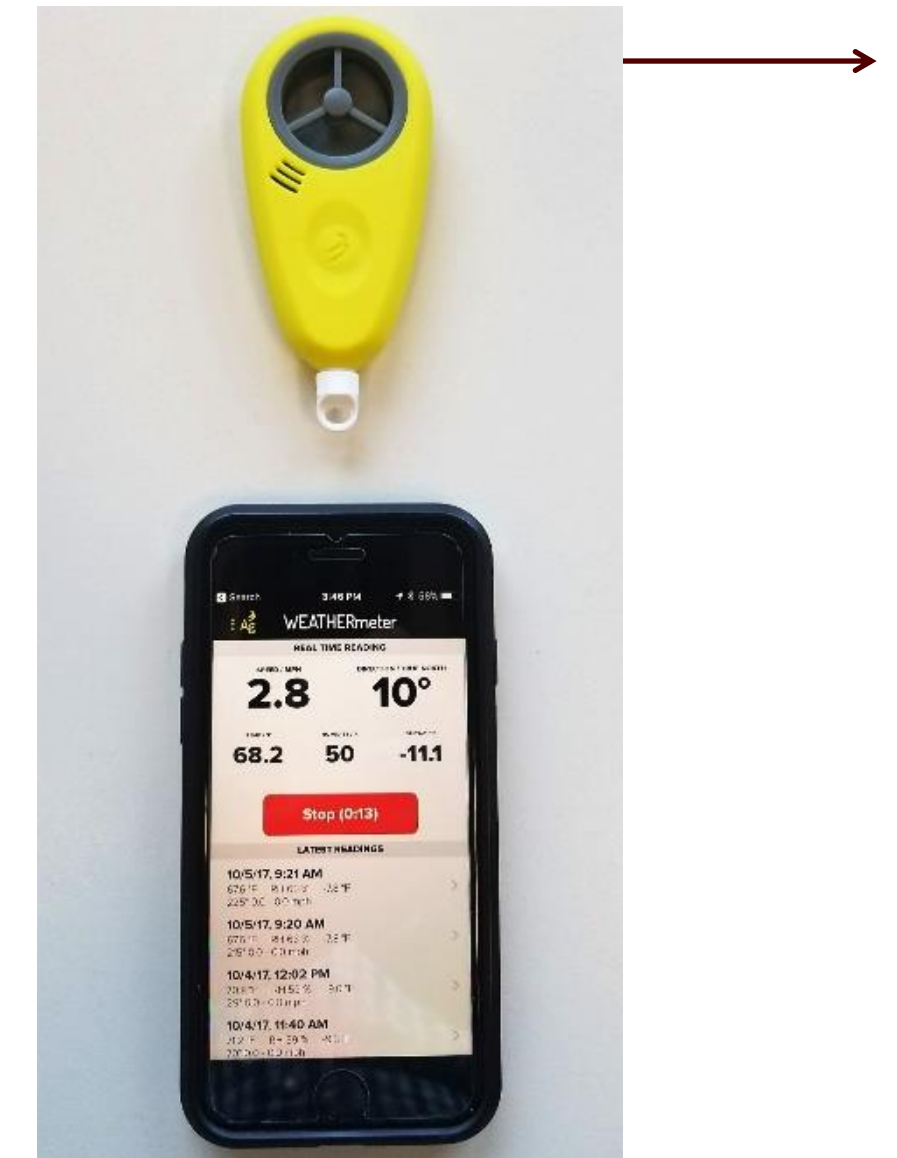
Know your surroundings

–What is downwind?

–What is beyond what you can't see?

Application direction

Topography



Adapted from Survey of Climatology:
Griffiths and Driscoll,
Texas A&M University, 1982

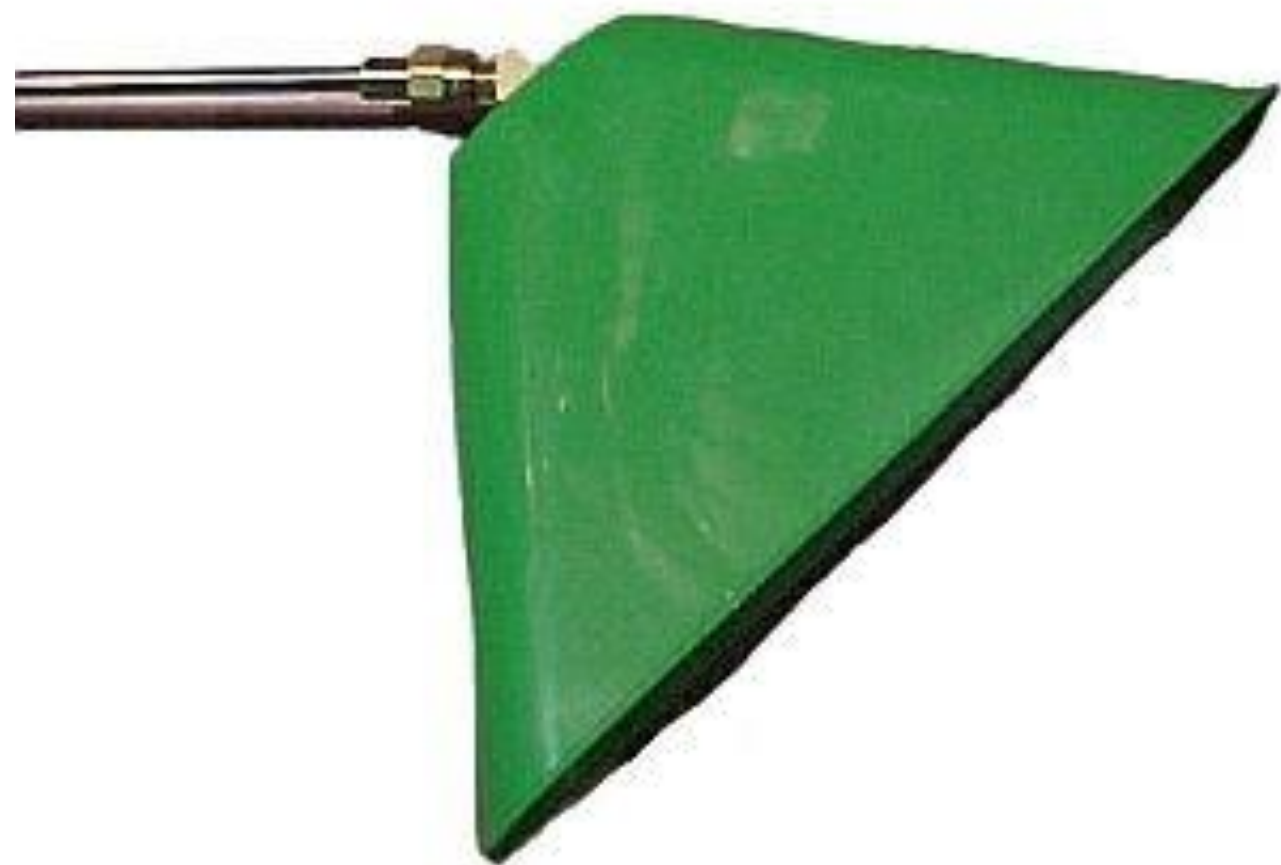
Off-Target Movement

Reducing your risk



If spot-spraying, use a shield around the spray nozzle to prevent spray drift onto desirable plants.

Consider using hooded broadcast sprayer if feasible.



Off-Target Movement

Reducing your risk



- Use good drift reduction nozzles that produce large droplets, use a drift reduction agent (DRA)
- Keep your boom as low as possible
- Don't spray when wind is blowing toward sensitive crops/plants
- Communication/know what is around you!



Thank you!

- **Contact Info**
- Mobile: (979) 318-2358
- email: scott.nolte@ag.tamu.edu

Takeaway



Positive Weed ID
Maintain Equipment
Rate and Weed Size
Soil Conditions
Climatic Conditions
Adjust for Weed Factors
Scout for Resistance
Keep Spray on-Target!