

Weed Control in Rights of Ways:

Factors that Affect Herbicide Efficacy

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Outline

- Introduction
- Reasons why herbicide efficacy can be reduced
 - Weed biology and ecology
 - Environment
 - Herbicide and herbicide applicator
- Considerations and BMPs

Introduction

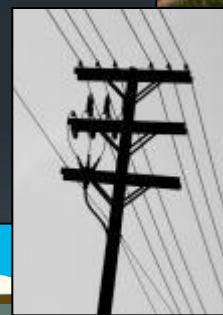
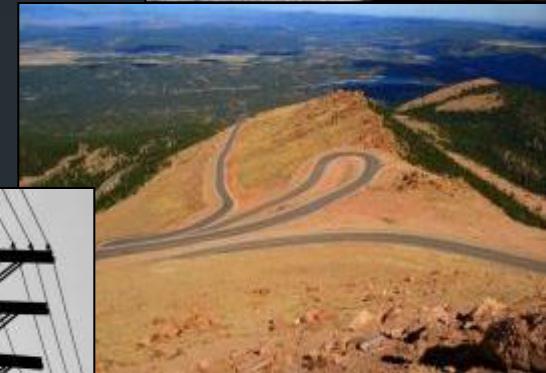
- Rights-of-way (ROW)
 - Federal, state, county, township, city roads
 - Public airports
 - Railroads
 - Electric utilities
 - Pumping stations and pipelines
 - Public irrigation waterways
 - Bicycle, bridle and other public paths/trails
 - More

Introduction

- Reasons for vegetation management

- Reduce safety hazards
 - *Line-of-site/visibility*
 - *Remove fire hazards*
 - *Remove habitat for undesirable wildlife*

- Prevent the disruption of services
 - *Transportation of goods*
 - *Utilities*



Introduction

- Reasons for vegetation management
 - Protecting structures
 - *Road- and rail-beds*
 - *Utility poles or supports*
 - *Pumping stations*
 - Provide ecological services/enhance aesthetics
 - *Remove pests of crops/hosts to pests of crops*
 - *Remove plants inhibiting desired vegetation*
 - *Improve scenic resources*
 - Maintain public relations



Strategies for managing vegetation

- Mechanical
 - i.e. mowing, pruning
- Biological
 - i.e. grazing
- Cultural
 - i.e. controlled burning, fertilizing/liming, mulching
- Chemical
 - i.e. tree growth regulators
 - i.e. herbicides

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Weed Biology and Ecology

- Life form
 - i.e. Broadleaves vs. grasses
- Life cycle
 - i.e. Annuals vs. perennials
- Morphology
 - i.e. Leaf surface area, angle and texture
- Growth and development
 - i.e. Plant size, plant maturity, plant responses to stress
- Genetics
 - Development of herbicide resistance

Life Form

- Weed identification is necessary for designing an effective weed control program
- Weed species may respond differently to different weed control practices
- Monocots
 - Grasses
- Dicots
 - Broadleaves



Certain herbicides like Garlon (triclopyr), and Banvel (dicamba) are injurious to broadleaves weed species, but not grasses at labeled rates



Life Cycle

- Weeds are also categorized by how long they live and how they reproduce
- Life history traits can affect the timing/efficacy of weed control practices
- Annuals (summer, winter)
 - Complete life cycle in one year
 - Easiest to control as seedlings, manage before seed set
 - Emergence within/across years
 - Disturbed sites
- Perennials
 - Reproduce by seed or vegetatively
 - Rhizomes, stolons, rootstocks, tubers
 - Persistent and difficult to control



Morphology, Growth and Development

- Location of growing points
- Leaf shape
- Hairs
- Size
- Response to stress



The shape and orientation of grass leaves (narrow and more vertical than dicots) may affect herbicide deposition and, therefore, efficacy

Growing points of grasses are below the ground, which will not be injured by contact herbicides



Leaf hairs can either limit herbicide absorption by holding droplets away from the leaf surface (dense layer of hairs) or else allow for greater retention (thin layer of hairs).

Seedlings are often less hairy than mature plants.

Surfactants can be used to improve spreading and sticking





Herbicides, especially the systemics, are most effective against actively growing plants

Plants that are subjected to water stress will have thickened cuticles (waxy layer on the surface of the leaf), reduced transpiration, and limited physiological activity



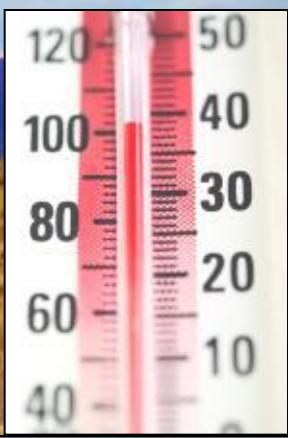
Under these conditions, herbicides are less likely to be absorbed and translocated

Can't interrupt biochemical processes that are barely occurring



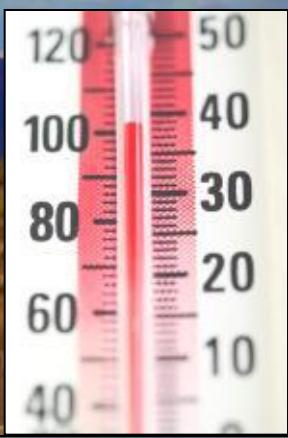
Environment

- Soil
 - Clay, OM can make herbicides unavailable
 - In less adsorptive soils, leaching can occur
 - Slope can lead to erosion or drainage



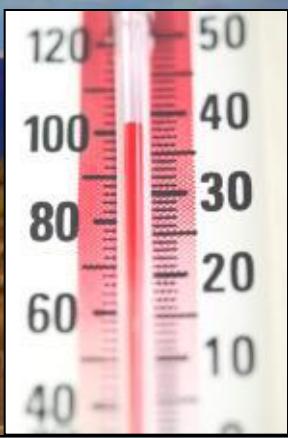
Environment

- Water
 - Soil moisture
 - *Needed for activation of residual herbicides*
 - Precipitation
 - *Activation of herbicides*
 - *Erosion, leaching*
 - *Rain-fastness*
 - Humidity
 - *Absorption*
 - *Translocation*



Environment

- Temperature
 - Plant affects
 - *Plant growth rate*
 - *Cuticle development/herbicide absorption*
 - *Water/herbicide translocation*
 - Herbicide affects
 - *Volatilization*
 - *Degradation*
- Wind
 - Spray drift
 - Drought stress



Herbicide Selection

- Classification
- Method of application
 - Soil-applied (pre-emergent)
 - Active on newly emerged seedlings or underground vegetative structures
 - Many products persist in the soil in an active form and provide 'residual' control over a period of time
 - i.e. sulfometuron, diuron, oryzalin
 - Foliar-applied (post-emergent)
 - Control of vegetation through direct contact or by being translocated, to the site of action
 - i.e. glyphosate (systemic), triclopyr (systemic)

Herbicide Selection

- Classification
- Selectivity
- Non-selective
 - Kills all vegetation
 - i.e. glyphosate, MSMA, glufosinate
- Selective
 - Controls specific types of vegetation
 - i.e. 2,4-D, triclopyr, sulfometuron

Herbicide Selection

- Classification
- Mode/site of action
 - *<http://wssa.net/weed/resistance/>*
- Formulation
 - *<http://plantscience.psu.edu/research/projects/vegetative-management/publications/herbicide-applicator-training/module-11-herbicide-formulations-and-adjuvants/view>*

Spray Solution

- Water quality (Spray solutions are >95% water)
- What goes in can affect what comes out: The case of glyphosate
 - *pH – high pH causes glyphosate to dissociate*
 - *Cations – Mg, Ca, Na can bind to glyphosate*
 - *Turbidity – glyphosate rapidly and tightly bound to soil and OM*



The screenshot shows a blog article from farmgateblog.com. The header features a large orange vertical bar on the left. The main content area has a white background with a black border. At the top, there's a photo of a corn truck, the text 'BIG YIELDS' in large letters, and the LG Seeds logo. Below this, the blog's name 'farmgateblog.com' is displayed in a large blue font, with the tagline 'WHERE FARM DECISION-MAKERS START THEIR DAY' in smaller orange text. The article title 'Is Your Spray Water Killing Your Herbicide Before The Herbicide Kills The Weeds?' is in blue. At the bottom, there's a 'Tweet' button with a count of 2, and a 'ASK' logo with a question mark icon.

www.farmgateblog.com/article/1563/is-your-spray-water-killing-your-herbicide-before-the-herbicide-kills-the-w

BIG YIELDS
www.lgseeds.com

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WHERE FARM DECISION-MAKERS START THEIR DAY

« Back to main

Tuesday, March 20, 2012

Is Your Spray Water Killing Your Herbicide Before The Herbicide Kills The Weeds?

 Tweet 2

ASK

Spray Solution

- Spray Additives
 - Spray adjuvants (additives) are added to enhance the performance or handling of a pesticide
 - Adjuvants are usually classified according to their use rather than their chemistry
 - Activator adjuvants and modifier adjuvants
 - Activator additives increase the POST activity of herbicides, usually by increasing herbicide movement into the leaf tissue (e.g. oils, surfactants, and fertilizers)
 - Modifier additives alter the application characteristics of the spray solution (e.g. anti-foaming agents, compatibility agents, and drift control agents)

Spray Solution

- **Wetting agents** - allows wettable powders to mix with water.
- **Emulsifiers** - allows petroleum based pesticides to mix with water.
- **Invert emulsifiers** - allows water based pesticides to mix with a petroleum carrier.
- **Spreaders** - allows pesticides to form a uniform coating layer over the treated surface.
- **Stickers** - Allows the pesticide to stay on the treated surface and no roll off.
- **Penetrants** - Allows the pesticide to get through the outer surface to the inside of the treated areas. This is commonly used when penetrating the thick gel of some water plants.
- **Foaming agents** - Used to reduce drift so the pesticide stays in the target area.
- **Safeners** - To reduce the toxicity of a pesticide formulation to the handler or treated surface.
- **Anti-foaming agents** - Reduces the foaming of spray mixtures that require vigorous agitation.

Making sense of adjuvants

www.herbicide-adjuvants.com

Compendium of Herbicide Adjuvants, 11th Edition

[SIU Weed Science Homepage](#)

[Adjuvant Products by Name](#)

[Adjuvant Products by Category](#)

[Adjuvant Products by Manufacturer](#)

[Crop Based Adjuvant Products](#)

[Adjuvant Products Added Since Printing](#)

[Glossary of Terms](#)

[Names and Addresses of Mfg/Dist](#)

[About Adjuvant Product Labels linked on this website](#)

[How to Buy the Booklet](#)

- other links -

[Log On for registered Mfg/Distributors only](#)

[How to register](#)

[Other Resources](#)

[SIUC Weed Science](#)

[SIUC Plant, Soil and Vegetable Oil](#)

[Nitrogen Source](#)

[Nonionic Surfactant](#)

[Organic-Silicone Surfactant](#)

[Other](#)

[Scent](#)

[Spreader-Sticker](#)

[Surfactant plus Nitrogen Source](#)

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COMMENTS ON THE 2012 COMPENDIUM

The 2012 Compendium of Herbicide Adjuvants is the 11th edition of the biennial publication and contains 687 entries from 38 companies. The 1st Edition of this Compendium was assembled in 1992 with 76 entries from 22 companies. The growth of the adjuvant products listed is a result of: continued reliance on postemergence herbicide applications, scientific advancements and innovations pertaining to herbicide adjuvants, blending adjuvant chemistry into a single product for use with specific herbicides, and successful research and development by adjuvant manufacturers for commercialization of novel, multifunctional adjuvant products.

Each new edition of the booklet reflects the change in commercial adjuvant products in our website database over a two-year period since the previous publication. The products are organized by type of adjuvant such as nonionic surfactants, crop oil concentrates, etc. Product name, principal functioning agent, use rate, any special comments, and

[ACCUQUEST WM Label/MSDS](#)

[ACCUZONE DC Label/MSDS](#)

Water Conditioning Agent

Water Conditioning Agent

This information was provided by the adjuvant manufacturers/distributors.

matched your request.

MANUFACTURER/DISTRIBUTOR	ADJUVANT CATEGORY	PRINCIPAL FUNCTIONING AGENTS	USE RANGE	COMMENTS
Chemorse, Ltd.	Deposition (Drift Control) and/or Retention Agent plus Ammonium Sulfate and Defoamer and Water Conditioning Agent and Nitrogen Source	Ammonium sulfate, drift retardant, antifoam	2.5-5% v/v	
Helena Chemical Co.	Deposition (Drift Control) and/or Retention Agent plus Ammonium Sulfate and Defoamer and Water Conditioning Agent and Nitrogen Source	Proprietary blend of polyhydroxycarboxylic acids, sulfates, and polymeric deposition agents	0.5-1% v/v	Deposition
Helena Chemical Co.	Deposition (Drift Control) and/or Retention Agent	Ammonium and potassium salts plus organic polymers	1-2.5 lb/A	

Application equipment

- Equipment must be clean and in proper working order to ensure proper application and maximize herbicide efficacy
 - Tank and agitator
 - Pump and pressure gauge
 - *Pressure control is important for proper application as it determines the amount of spray delivered by the nozzles*
 - Hoses
 - Strainers
 - Nozzles and nozzle assembly
 - *Breaks the spray into droplets and forms the pattern of distribution*
 - *Nozzles are designed for specific spraying jobs at certain pressures*



TeeJet® Broadcast Nozzle Selection Guide

	SOIL APPLIED	HERBICIDES		FUNGICIDES	
		POST-EMERGENCE		CONTACT	SYSTEMIC
		CONTACT	SYSTEMIC		
	Turbo Teejet® Reference page 9		VERY GOOD	VERY GOOD	VERY GOOD
	Turbo Teejet® at pressures below 30 PSI (2.0 bar) Reference page 9	GOOD	GOOD	EXCELLENT	GOOD
	Turbo Twinjet® Reference page 10	GOOD	EXCELLENT	EXCELLENT	EXCELLENT
	Turbo Twinjet® at pressures below 30 PSI (2.0 bar) Reference page 10	VERY GOOD	VERY GOOD	EXCELLENT	VERY GOOD
	Turbo Teejet® Induction Reference page 11	EXCELLENT		EXCELLENT	
	XR, XRC Teejet® Reference pages 12–13		EXCELLENT	GOOD	EXCELLENT
	XR, XRC Teejet® at pressures below 30 PSI (2.0 bar) Reference pages 12–13	GOOD	GOOD	VERY GOOD	GOOD
	AI, AIC Teejet® Reference page 14	VERY GOOD	GOOD	EXCELLENT	GOOD
	AI, AIC Teejet® Reference pages 15–16	VERY GOOD	GOOD	EXCELLENT	GOOD
	Twinjet® Reference page 17		EXCELLENT		EXCELLENT
	DG Twinjet® Reference page 18	VERY GOOD	VERY GOOD	EXCELLENT	VERY GOOD
	Turbo Teejet® Duo Reference page 19		EXCELLENT	EXCELLENT	EXCELLENT
	Turbo Teejet® Duo at lower pressures Reference page 19	VERY GOOD	VERY GOOD	EXCELLENT	VERY GOOD
	Turbo FloodJet® Reference page 23	EXCELLENT		VERY GOOD	VERY GOOD
	Turjet® Reference page 24	EXCELLENT		EXCELLENT	EXCELLENT
	QCTF Turbo FloodJet® Reference page 25	EXCELLENT			
	AirMatic AirJet® Reference page 137	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT

Note: Consult the chemical manufacturer's product label for specific rate and application recommendations.

	PSI									
	20	25	30	35	40	50	60	70	80	90
TTJ60-11002	C	C	C	C	C	M	M	M	M	M
TTJ60-110025	VC	C	C	C	C	C	C	M	M	M
TTJ60-11003	VC	C	C	C	C	C	C	C	M	M
TTJ60-11004	VC	C	C	C	C	C	C	C	C	M
TTJ60-11005	VC	C	C	C	C	C	C	C	C	C
TTJ60-11006	XC	VC	VC	C	C	C	C	C	C	C

Herbicide Drift

- Once a herbicide is released into the air, it can be moved off-target
- Uncontrolled movement in air can be either from volatilization or particle drift



Herbicide Drift

- Volatilization - occurs when there is a physical change of the herbicide into gas, which can then be moved off-target via air currents
- Volatility potential increases:
 - As *air temperature increases*
 - As *surface temperature increases*
 - As *relative humidity decreases*



Herbicide Drift

- Drift - occurs when wind physically moves *the herbicide and the carrier* from the target site during the spraying operation
- Drift potential increases:
 - As *droplet or particle size decreases*
 - As *wind speed increases*



SUMMARY OF INFLUENCES OF VARIOUS FACTORS ON SPRAY DRIFT

Factor	More Drift	Less Drift
Spray particle size	Smaller	Larger
Release height	Higher	Lower
Wind speed	Higher	Lower
Spray pressure	Higher	Lower
Nozzle Size	Smaller	Larger
Nozzle Orientation (aircraft)	Forward	Backward
Nozzle Location (aircraft)	Beyond 2/3 wing span	2/3 or less wing span
Air Temperature	Higher	Lower
Relative Humidity	Lower	Higher
Nozzle Type	Produce Small Droplets	Produce Larger Droplets

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Considerations

- Groundwater advisories
- Injury to desirable plants
- Brownouts
- Hazards to pollinators
- Hazards to livestock, wildlife, endangered species

BMPs

- Know your weeds, know your site
 - *Vegetation present (on- and off-site), vegetation desired*
 - *Site characteristics that influence vegetation management*
- Read the herbicide label
- Take control of what you can
 - *Weeds are complex*
 - *Weed-environment interactions are even more complex*
 - *Weed-environment-herbicide interactions are really complex*
- **NOTHING** is a substitute for your own eyes and mind!

Thank you...

