

Impacts of Water Quality on Pesticide Efficacy

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Importance of Water Quality

- Why is water quality important?
 - **Water is the primary diluent.*
- For example: Spray equipment calibrated at 30 GPA would deliver 99% water solution if delivering a pesticide product at 1 pint per acre.

Potential indicators of water quality problems

- Common complaints
 - That pesticide didn't have any residual, I need to re-apply every few weeks.
 - That chemical doesn't work at the labeled rates.
 - My pests are resistant to this chemical.
 - They are full of it! That pesticide doesn't work.



Water Quality Parameters

Physical indicators

- water temperature
- Conductivity
- Total suspended solids
- Turbidity

Chemical indicators

- pH
- Biochemical oxygen demand
- Chemical oxygen demand
- Dissolved oxygen
- Total hardness

Biological indicators

- E. coli

• Total dissolved solids

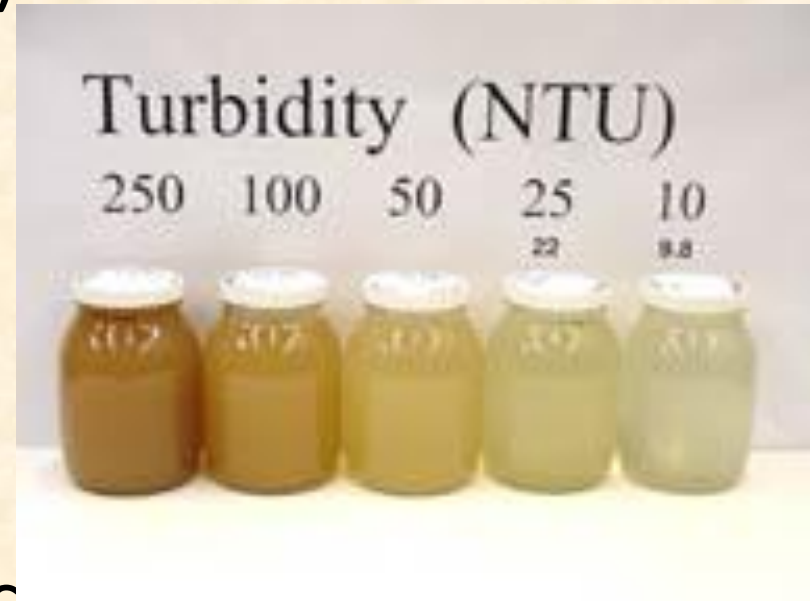
- Odor
- Color
- taste

- Heavy metals
- Nitrate
- Orthophosphates
- Pesticides
- Surfactants
- Alkalinity

- Coliform bacteria
- Other microscopic larvae

Turbidity

- Total suspended solids (TSS) is the water containing suspended solids, soil, or organic matter
 - Reduces effectiveness of many herbicides.
- Measured in Nephelometric Turbidity Units (mg/L)



Why is turbidity a problem?

- ▣ Pesticides with a high sorption potential (KOC) will stick to suspended sediments reducing pesticide effectiveness.
 - Imazapyr (100 KOC)
 - Aminopyralid (2,500 KOC)
 - Glyphosate (24,000 KOC)
 - Permethrin (100,000 KOC)



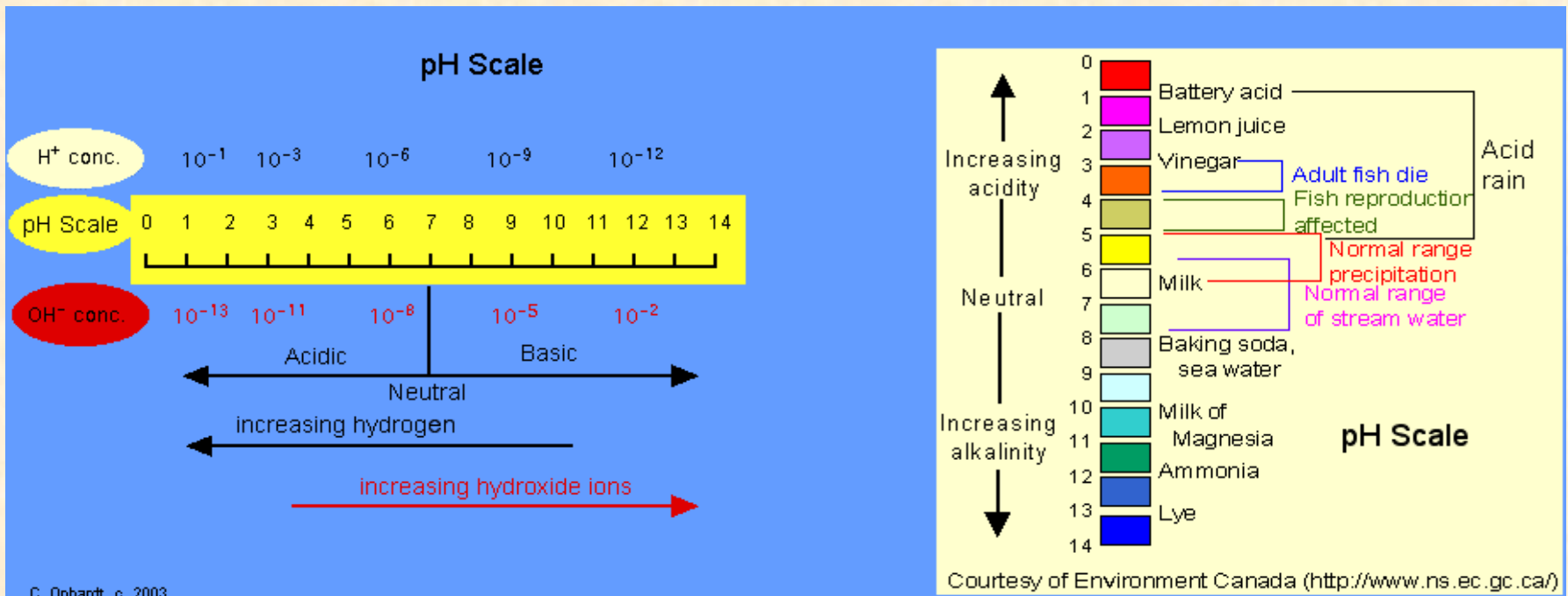
How to Monitor Turbidity

- Drop a quarter to the bottom of a 5 gallon bucket.
 - If you can't see the quarter then the water must be treated or replaced.
- Locate an alternative water source
- Install inline filters



What is pH?

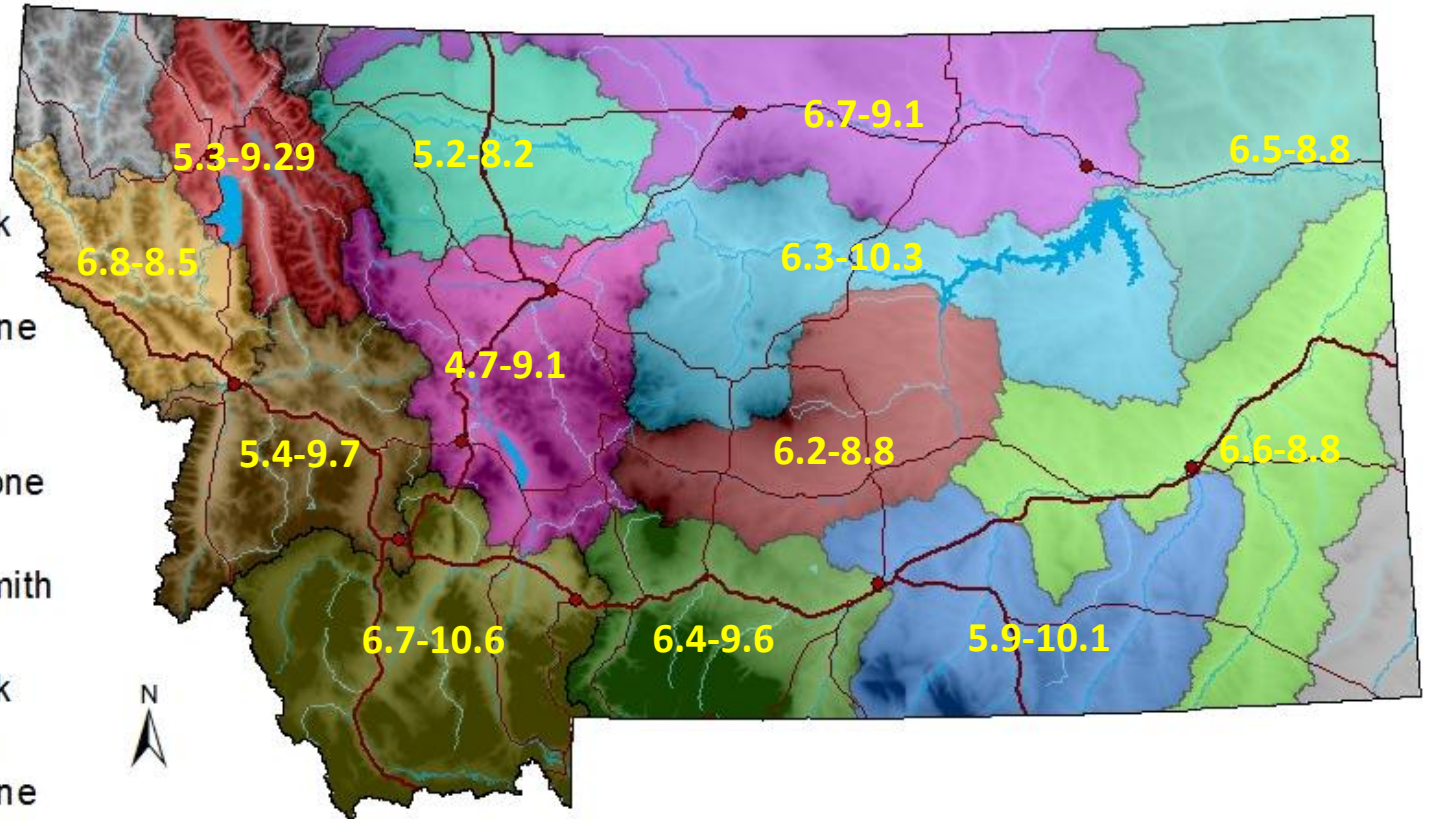
- Is the measure of the concentration of hydrogen ions (H^+) and hydroxide ions (OH^-) in a solution.
- Scale is logarithmic from 0 - 14
 - Hydrogen predominates (acidic < 7)
 - Hydroxide predominates (alkaline > 7)



pH ranges in MDA monitoring wells

Major River Watersheds

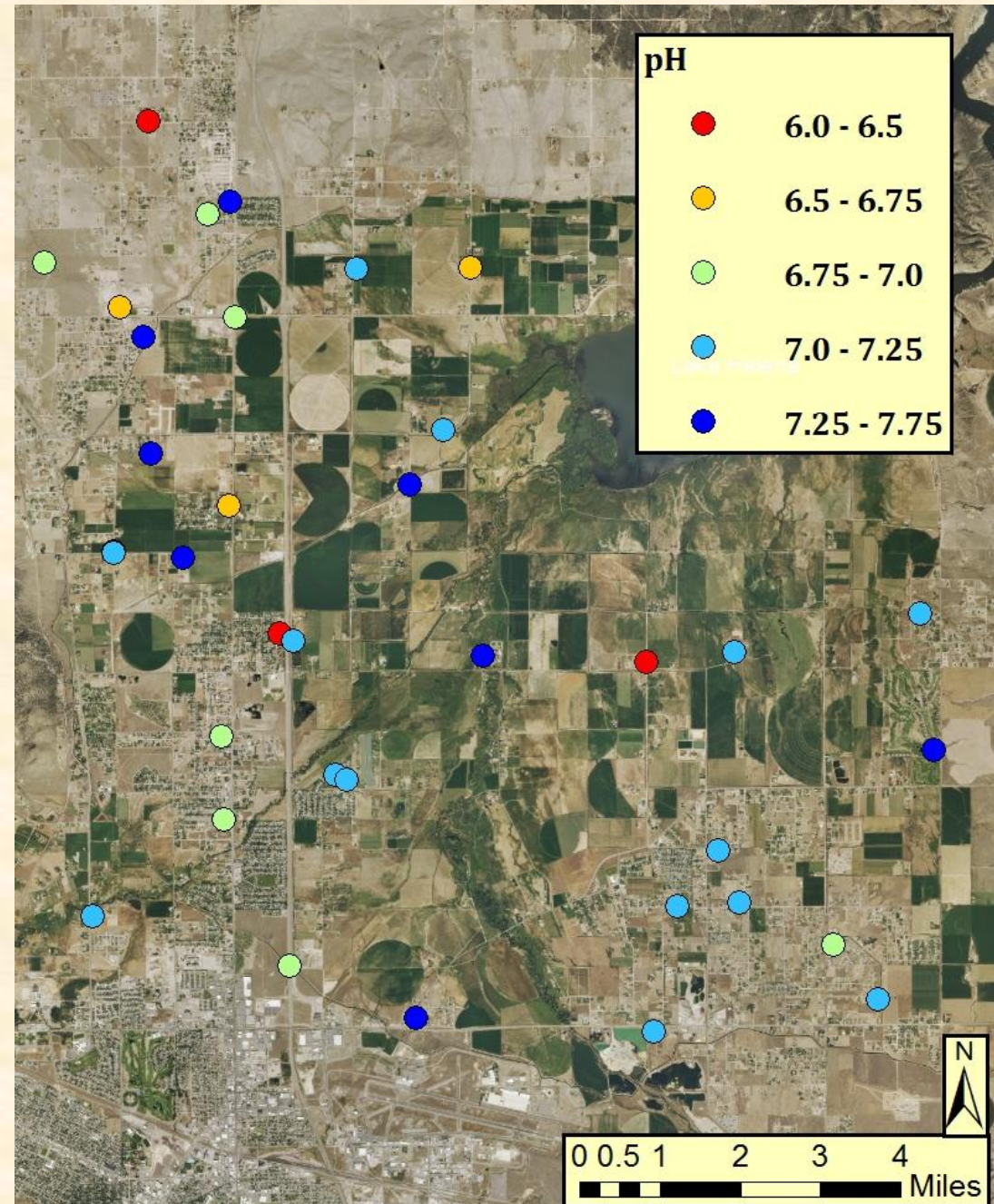
- Flathead
- Hudson Bay
- Kootenai
- Little Missouri
- Lower Clark Fork
- Lower Missouri
- Lower Yellowstone
- Marias
- Middle Missouri
- Middle Yellowstone
- Milk
- Missouri-Sun-Smith
- Mussellshell
- Upper Clark Fork
- Upper Missouri
- Upper Yellowstone



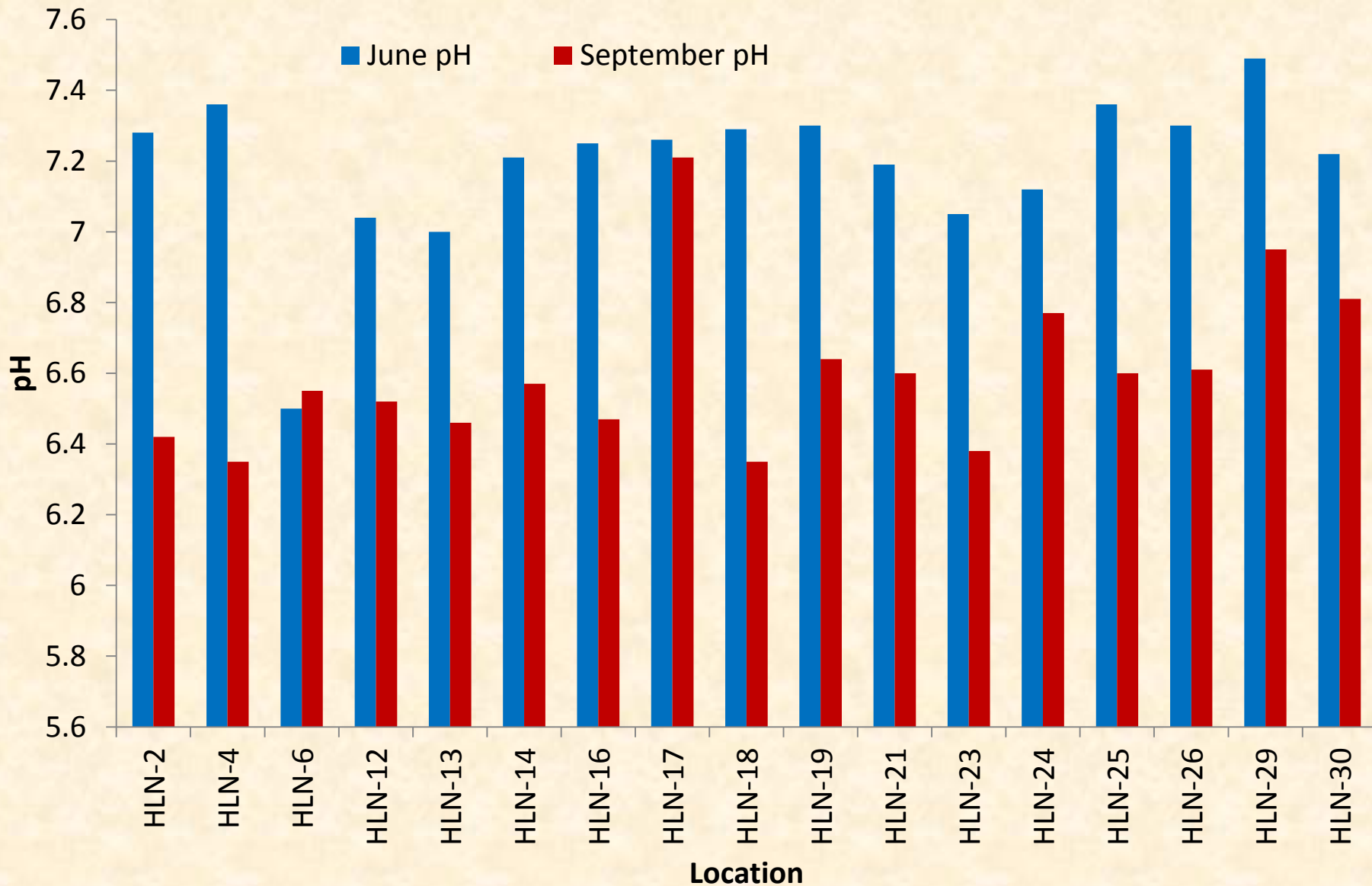
- pH can vary with location and season, so test pH every time.

Helena Valley groundwater pH

- Samples collected over a 3 day period in June 2014
- Wells ranged in depth from 16 to 160 feet bgs

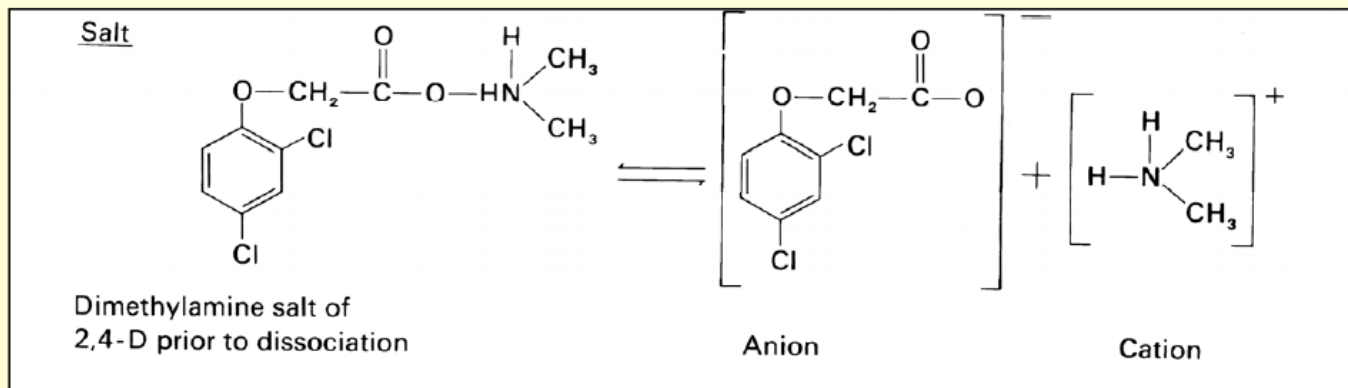


Helena Valley groundwater pH



Dissociation from alkaline hydrolysis

- Dissociation is the breaking down of a complex molecule into simpler units.
- Efficacy often goes down when molecules are dissociated. Plants often won't absorb the chemical as well. At times this may totally inactivate the pesticide.
- Weak Acid Herbicides are the most susceptible to alkaline dissociation
 - Roundup[®] (glyphosate)
 - Pursuit[®] (ammonium salt of imazethapyr)
 - Liberty[®] (glufosinate ammonium).
 - 2-4,D salt



Dissociation from Acid Hydrolysis

- Some pesticides are vulnerable to breaking down in a low pH solution.
 - Sulfonyl urea (SU) herbicides (Escort, Ally) tend to break down more rapidly when the pH is < 6 .
- This is more common in forested mountain areas of western MT



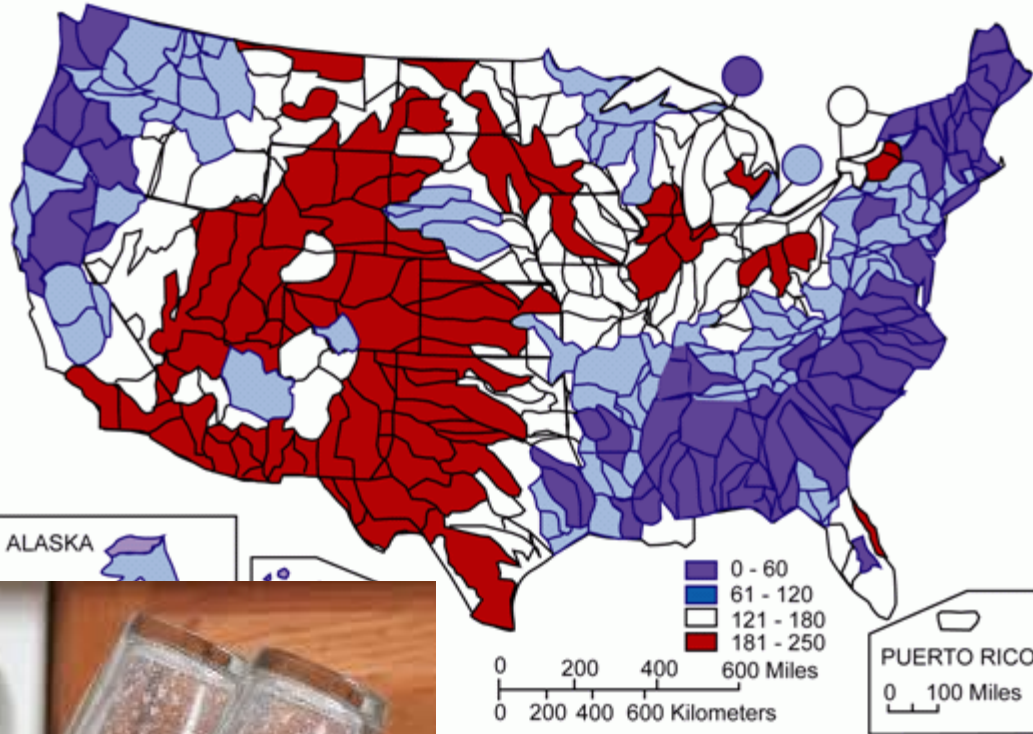
Hardness and TDS

- Hardness is the amount of dissolved positively charged calcium and magnesium (and a few other metals) in the water.]
 - Responsible for the soap scum in the shower and spots on glasses.
- TDS is the concentration of positive and negative charged minerals dissolved in water.
- Primary composed of six major minerals:

Positive Charge	Negative Charge
Calcium (Ca ²⁺)	Sulfate (SO ₄ ²⁻)
Magnesium (Mg ²⁺)	Chloride (Cl ⁻)
Sodium (Na ⁺)	Bicarbonate (HCO ₃ ⁻)

Signs of hard water

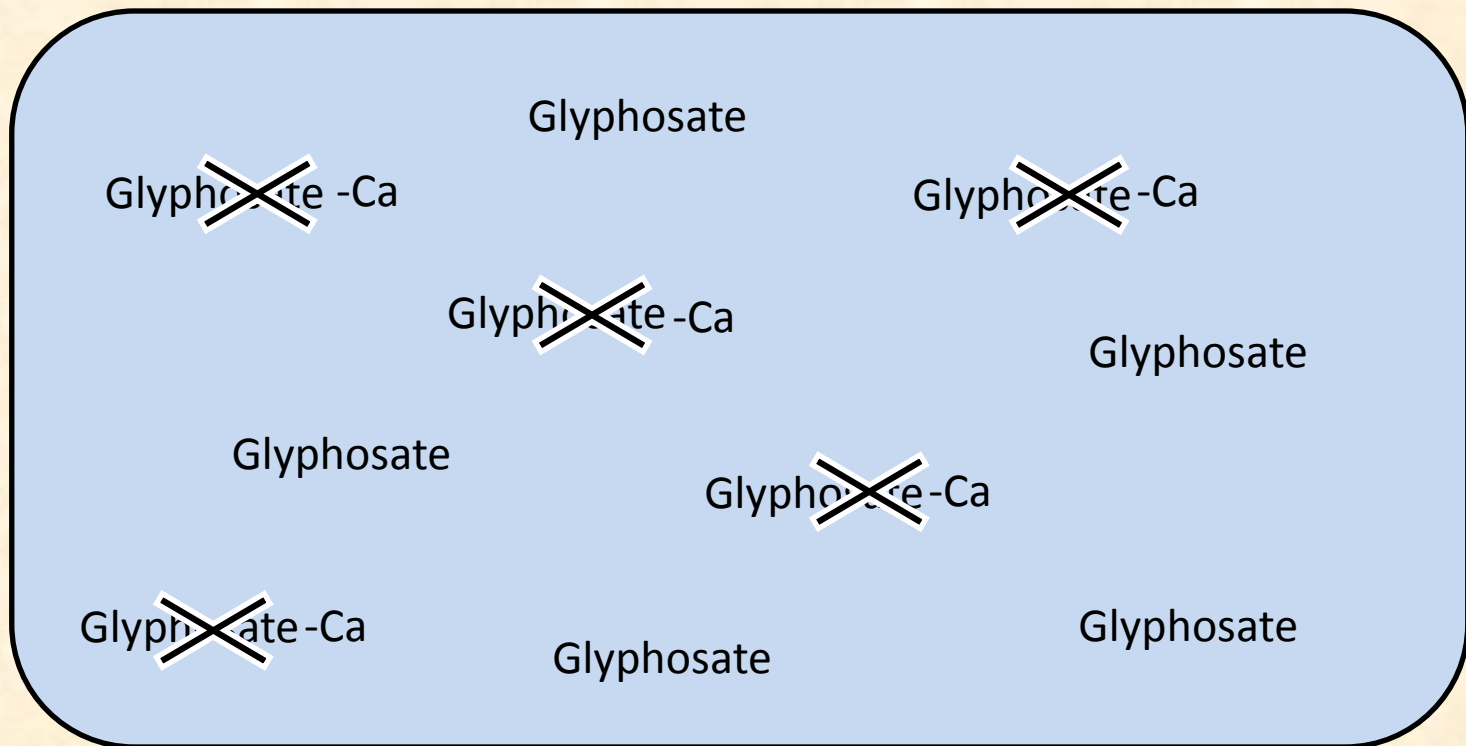
CONCENTRATION OF HARDNESS AS CALCIUM CARBONATE,
IN MILLIGRAMS PER LITER



Why is TDS and hardness a problem?

- Dissolved ions like calcium and magnesium can bond with active ingredients and reduce plant absorption.

Spray tank



When are hardness and TDS a problem?

- ▣ If you have a total hardness of **>150 ppm** action should be considered before using pesticides like:
 - 2,4-D amine
 - totally deactivated at 500 ppm
 - Glyphosate (Roundup)
 - sethoxydim (Poast)
 - Imazethapyr (Pursuit)

Summary Tips for Water

▣ Check the water pH

- If greater than 7.5 and using an organophosphate, carbamate, or a weak acid herbicide check label for pH recommendations.
- If less than 6.5 and using sulfonyl urea herbicides check label for pH recommendations.

▣ Test the hardness of your water

- If over 150 ppm consider adding adjuvants or alternative water source.

▣ Test the turbidity of your water

- If water is murky consider an alternative water source or filtration.

Water Testing options

- At home test kits
 - Typically very cheap (<\$1 per sample)
 - Good for rough “ball park” values
- Lab testing
 - More expansive
 - The best option for really accurate measurements or if you want to know concentrations of specific ions.

At home kits



Lab Testing

- Certified Drinking Water labs in Montana
 - In Helena, MT
 - Alpine Analytical
 - DPHHS Environmental Laboratory
 - Energy Laboratories