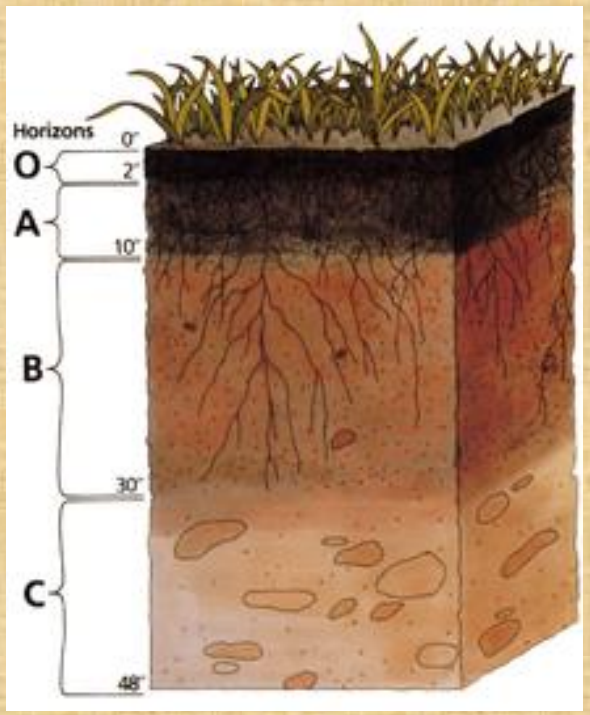
# Effects of pH on Herbicide Activity

November 16, 2017



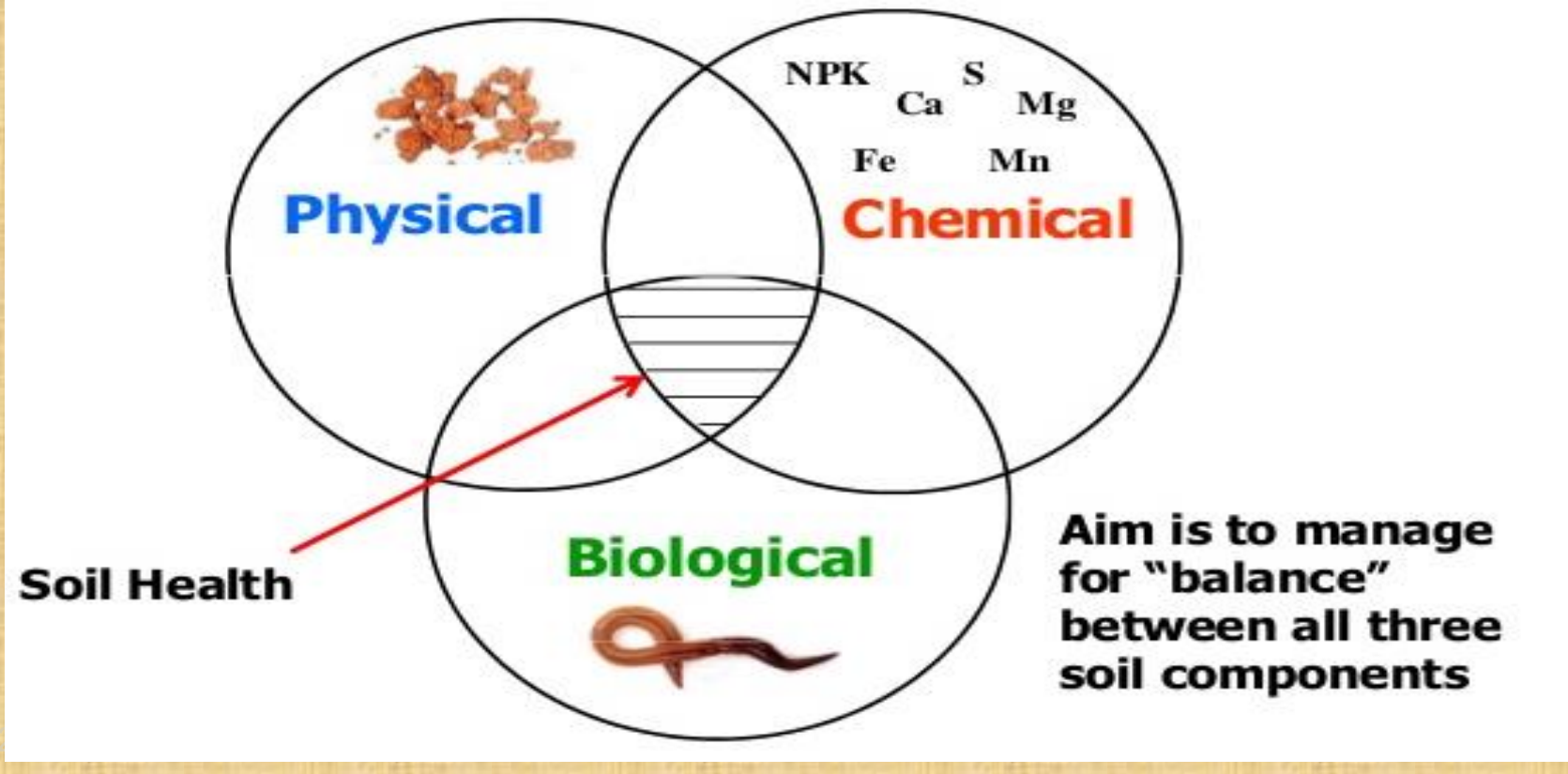

Stephen Van Vleet

# Recommendations

- Reduction in crop response

**Less stress**

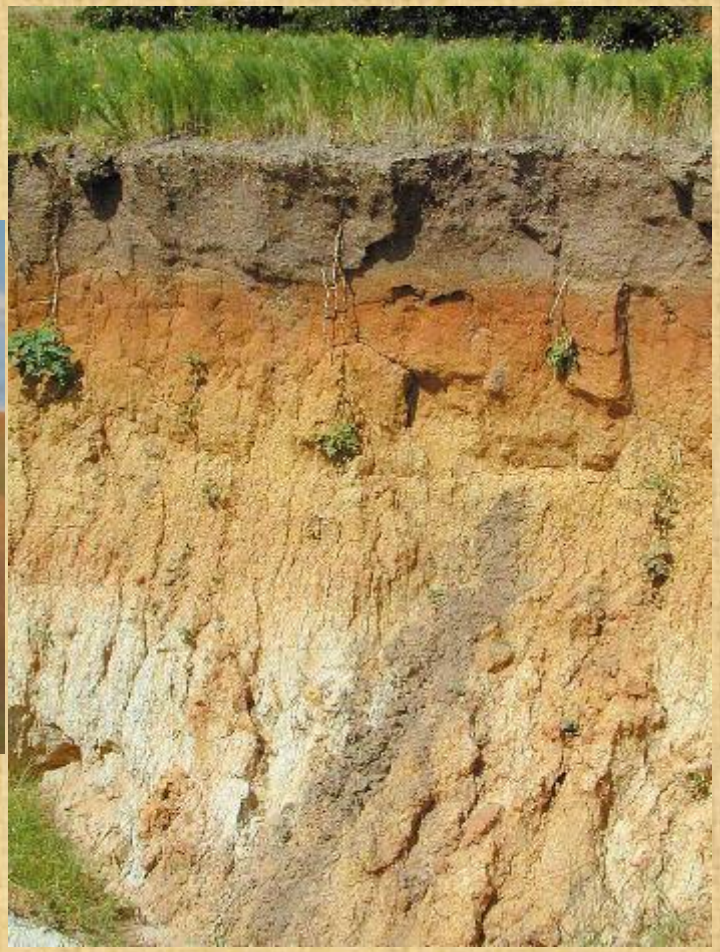
# Soil factors affecting herbicide persistence include soil composition, soil chemistry, and microbial activity.



# Soil Composition

# Soil Composition

Generally, soils high in clay, organic matter, or both have a greater potential for carryover because of increased binding of the herbicide to soil particles, with a corresponding decrease in leaching and loss through volatilization.



# Soil Chemistry

## pH

Low pH can affect the persistence of the triazine, sulfonylurea and imidazolinone herbicides

**As the soil pH drops below 6.0, these herbicides become increasingly bound, or adsorbed, to soil particles.**

**Adsorption of these herbicides appears to reduce their availability to soil microorganisms, the primary mechanisms of degradation.**

**The herbicide can still be released several months later, becoming available for plant uptake and potentially injuring a sensitive follow crop.**

# Microbial Activity

## Degredation

***Soil microorganisms*** **probably are the most important pathways responsible for the breakdown of herbicides**

**The types of microorganisms (fungi, bacteria, protozoans, etc.) and their relative numbers determine how quickly decomposition occurs.**

**Factors that affect microbial activity are moisture, temperature, pH, oxygen, and mineral nutrient supply.**

**Usually, well-infiltrating, fertile soil with a near-neutral pH is most favorable for microbial growth and, therefore, herbicide breakdown.**

# Microbial Activity

**The climatic variables involved in herbicide breakdown are *moisture, temperature,* and *sunlight*. Herbicide degradation rates generally increase as temperature and soil moisture increase, because both chemical and microbial degradation. Carryover problems are always greater the year following a drought.**

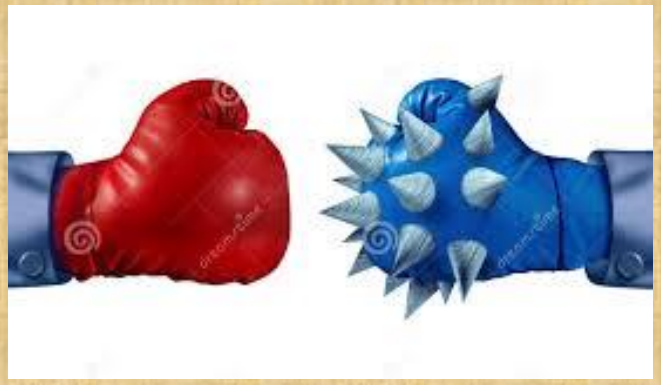
**Soil pH generally does not affect this process**

**Soil and climatic conditions that increase the persistence of selected herbicides or families**

| Importance | Dinitroanilines | Imidazolinones | Pyridines | Sulfonylureas |
|---|---|---|---|---|
| **Very Important** | low rainfall | low pH | Low rainfall | high pH |
| **Important** | high clay/ OM | high clay/OM | high clay/OM | high clay/OM |
| **Important -** | high or low soil pH | low rainfall | high or low pH | low rainfall |

# Who has the advantage?

**Soil acidity limits productivity on about 50% of Australia's cropland, "and several important weed species have a competitive advantage over crops on soils where the surface soil pH level is less than 5.5 or the subsurface pH is less than 4.8,"**



**Soil pH strongly influence how water (through hydrolysis) breaks down certain herbicides. Triazines and SU's are broken down through chemical hydrolysis in neutral or acid soils, This process is much slower in alkaline soils, potentially restricting crop choice and exposing late germinations of weed seed to sub-lethal doses of the herbicide."**

# Balancing Risk

- Try to keep at pH of 6.0 – 7.0
- Higher pH soils
  - More rapidly a pesticide breaks down
  - Increases the persistence and carryover potential of some herbicides
- Lower pH soils
  - More rapidly some pesticides break down
  - Increases the persistence and carryover potential of some herbicides

It depends on how they break down and what condition the soil biology is in

# Herbicide Properties

Properties affecting persistence include water solubility, vapor pressure, and the molecule's susceptibility to chemical or microbial degradation

*Leaching* is one mechanism responsible for herbicide dissipation.

include herbicide-soil binding properties, soil physical characteristics, rainfall frequency and intensity, herbicide concentration, and time of herbicide application.

Chemical structure: for example, 2,4-D allows microbes quickly to detoxify the molecule into inactive metabolites, whereas atrazine is not as prone to microbial attack

# Herbicide Properties

Banded herbicide applications?

Foliar applications?

Amount of tillage?

Herbicide Combinations?

Better or Worse

IT DEPENDS

Mid-west: e.g. soybean crop, may tolerate a certain level of atrazine residue, however, if another photosynthetic inhibitor such as metribuzin (Sencor) is applied to soybeans the year following atrazine-treated corn, soybean injury is more likely to occur.

# Herbicide Properties

**Pursuit:** Sugar beet production can be reduced when grown in soil conditions with a pH less than 6.5. If adjusting pH apply lime at least 12 months prior to planting rotational crop

**Osprey:** Best results are obtained at spray solution pH of 6.0 – 8.0

**Outrider:** Do not use other additives that alter the pH of spray solution to below 5.0. Do not use in fertilizer solutions of pH 5.0 or less. Do not use tank mixtures of this product when the wheat crop has insect damage, is under drought **stress** or when growth is negatively influenced by environmental **stresses**, such as nutrient deficiency, **poor soil pH** or disease

# Herbicide Properties

**Olympus:** Injury may occur when Olympus is applied to wheat planted in soils with a pH greater than 8, or less than 5 due to an unfavorable soil environment, stressing overall plant growth. This response may be further exacerbated by a rain event.

**Assure II:** Best results are obtained at spray solution pH of 6.0 – 8.0

**Zidua:** Avoid application to soils with less than 2% OM and/or pH greater than 7.5 because unacceptable crop injury may occur

# Beyond

## Early Label:

| Plant back interval | West of US Hwy 83 |
|---|---|
| **Anytime** | Clearfield crops and edible legumes |
| **Three months** | Alfalfa and **non-Clearfield Wheat** |
| **Nine months** | *** Barley**, Millet, Oat, Sunflower |
| **Eighteen months** | *** Barley** |
| **Twenty-six months** | Canola, Sugarbeet, Mustard |
| *** Barley: >18" precip and pH >6.2**<br>*** Barley: <18" precip or pH <6.2** | 9 months – no-plow or plow<br>No-plow = 18 months, plow = 9 months |

## Later:

| Non-Clearfield Wheat Rotational Interval based on pH and Moisture | | | |
|---|---|---|---|
| Washington and selected counties in Idaho and Oregon | | | |
| | | No Plow | Plow |
| **pH and Rainfall Requirements** | **>16" precip and pH >6.2** | 3 months | 3 months |
| | **<16" precip or pH <6.2** | 15 months | 15 months |

# Even Later (around 2016- early 2017):

| Plant back interval | West of US Hwy 83 |
|---|---|
| **Anytime** | Clearfield crops and edible legumes |
| **Three months** | Alfalfa and **non-Clearfield Wheat** [1] **&** [4] |
| **Nine months** | [1] **Barley**, [5] **Lentil**, Millet, Oat, Sunflower |
| **Eighteen months** | [1] **Barley, Lentil** |
| **Twenty-six months** | Canola, Sugarbeet, Mustard |

| **Barley Rotational Interval based on pH and Moisture** | | |
|---|---|---|
| Washington and selected counties in Idaho and Oregon | | |
| **pH and Rainfall Requirements** | **>16" precip and pH >6.2** | 9 months |
| | **<16" precip or pH <6.2** | 36 months |

| **Non-Clearfield Wheat Rotational Interval based on pH and Moisture** | | |
|---|---|---|
| Washington and selected counties in Idaho and Oregon | | |
| **pH and Rainfall Requirements** | **>16" precip and pH >6.2** | 9 months |
| | **<16" precip or pH <6.2** | 28 months |

# Everest

| Rotational Interval based on pH – Idaho, Oregon and Washington | | |
|---|---|---|
| **Crops** | **Interval for soils with pH at or <5.5** | **Interval for soils with pH 5.6 - 7.5** |
| **Spring or Winter Wheat** | 0 days | 0 days |
| **Sunflower** | 4 months | 4 months |
| **Barley** | 9 months | 11 months |
| **Canola** | 9 months | 9 months |
| **Alfalfa** | 11 months | 18 months |
| **Field peas** | 10 months | 18 months |
| **Garbs** | 10 months | 18 months |
| **Clearfield Lentils** | 10 months | 18 months |
| **Lentils** | 18 months | 24 months |
| **Mustard** | 24 months | 24 months |

# The soil & pH

- Higher pH
  - Su's
    - Increased persistence (builds in soils and not broken down)
      - More tightly bound at low pH, breakdown by hydrolysis
      - e.g. Increasing pH from 5-7, increases solubility from 548 ppm to 2,790 ppm of Ally
  - Beyond & Powerflex
    - Decreased persistence (more water soluble at high ph)
  - Curtail, Widematch
    - Decreased persistence (microbial degradation)
  - Metribuzin
    - Increased persistence (less positive charge = less soil tie up)
      - Breakdown by microbes
  - Paraquat
    - No change (bound tight to soil)
  - Glyphosate
    - No change (bound to soil cations, Ca, Fe, Al)

# Change in thought process (Paradigm shift)

- Change your planning process
- Change the herbicide mode of action
- Change the crop rotations and interval
- Change rates of herbicides

# Real Life Farming Scenario

Farmer K is from the Dalles, Oregon.
He farms 4000 acres in a wheat, summer fallow rotation.
Farmer is concerned about pH decline and significant yield reduction since 2000 when he began his no-till program. The wheat fields have even stand, with very small plants and roots in fair condition but no new white roots.
Soil samples were pulled to evaluate pH at every inch. The pH ranged from 4.8 to 5.4 in most cases with lowest numbers in 3-4 inch.
The micro-nutrient levels were poor and grower has not supplemented with micros.
What is the issue?

# Continued

The grower realized that he did apply beyond in the spring of 2015.

Solutions?

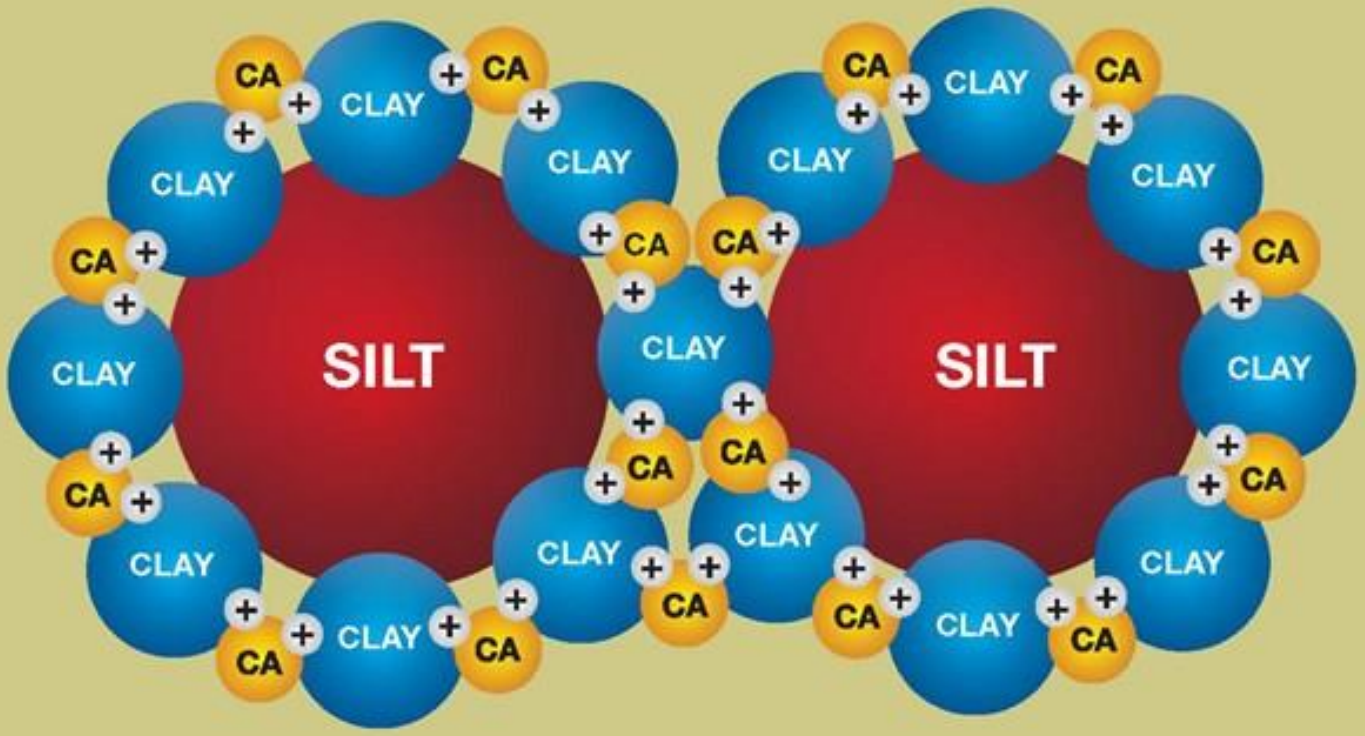
- The grower should supplement with Zinc, Boron, Copper and Chloride based on soil analysis
- The grower should apply lime
- The grower should have a bioassay for beyond carryover
- Plant imi-tolerant crop for one year without application of Beyond


DENIAL REALITY
fegGo


THAT'S ALL
FOLKS !

# Or Here!!!!!

# The Building Block of Soil Structure




**The role of calcium.** Each of calcium's positive charges attaches to a different clay particle. When larger particles of sand or silt are trapped between the clays, it creates a soil aggregate, a building block of soil structure.

**How to safeguard calcium.** When hydrogen ions are added to soil by plants, microbes, fertilizer and acid rain, calcium ions are lost. While losses vary, in a typical field 210 lb. of calcium per acre can be lost through erosion, 110 lb. through crop removal and 260 lb. by leaching—for a total of 580 lb.

You can't stop these processes from happening. But by testing soil regularly, understanding your test results and making frequent small applications of limestone, you can keep soil on an even keel, capable of maximum production.