# Herbicide carryover risks to sugar beet

Mark Bloomquist and Tom Peters

SMBSC Research Director and Extension Sugarbeet Agronomist

NDSU | EXTENSION

UNIVERSITY OF MINNESOTA EXTENSION

# Growing seasons with extended periods of drought conditions can increase potential for carryover injury from herbicides applied during the drought season to crops planted the following season.

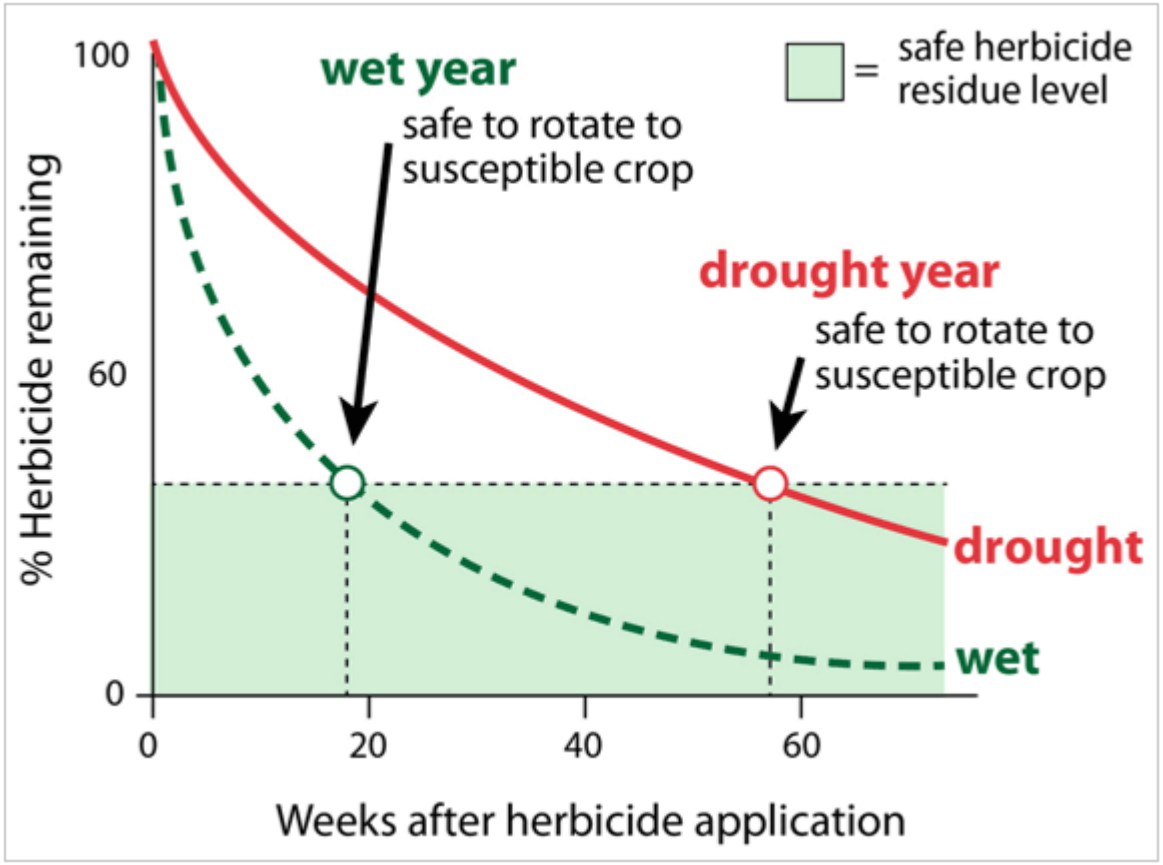
Damage to soybean from atrazine carryover. Dry conditions the previous year can lead to these symptoms if there is insufficient moisture for breakdown of the atrazine.

# Rainfall (inch) in Blomkest, Granite Falls and Morris, MN in 2021 compared to 30-year averages.[a]

| Month | Blomkest, MN | | Granite Falls, MN | | Morris, MN | |
|---|---|---|---|---|---|---|
| | 2021 | 30-yr Ave | 2021 | 30-yr Ave | 2021 | 30-yr Ave |
| | Inch | Inch | Inch | inch | Inch | Inch |
| April | 1.8 | 2.6 | 2.38 | 2.47 | 4.24 | 2.30 |
| May | 1.4 | 3.1 | 2.39 | 3.41 | 0.94 | 3.03 |
| June | 1.3 | 4.8 | 0.32 | 4.35 | 0.82 | 4.27 |
| July | 1.7 | 3.7 | 1.87 | 3.12 | 2.13 | 4.18 |
| August | 5.0 | 3.8 | 5.56 | 4.04 | 5.06 | 3.51 |

[a]Monthly and 30-yr averages from NOAA

# Herbicides may persist longer in dry vs. wet soils




- Pesticide labels provide guidance for crop rotation restrictions
- Environmental conditions, especially rainfall will ultimately determine persistence of herbicides

Colquhoun, J. 2006. Herbicide persistence and carryover. University of Wisconsin Extension publication A3819.

# How do herbicides degrade in soil?

- Degradation is the conversion of active herbicide molecules to products that no longer have herbicidal activity.
- Degradation rate is frequently described as half-life, the time required for half of the herbicide molecules to degrade from the soil.
- Herbicides with longer half-lives tend to be more persistent and have higher potential for carryover to crops in sequence.
- Both PRE and POST herbicides may persist in soils.

# There are several ways herbicides are degraded /deactivated in soil.

- Breakdown / degradation by soil microbes – most common.
- Breakdown by chemical hydrolysis (water breaks herbicide molecules into less active pieces).
- Herbicide escaping to the atmosphere as a gas (volatilization).
- Breakdown by light (photo degradation).
- Herbicides tightly bound to soil colloids.

**Degradation: Microbial**

- Important means for destroying pesticide in soils
- Some soil microorganisms use pesticides as food
  - bacteria and fungi

# Factors affecting herbicide carryover

- **Herbicide itself**
  - The chemical structure of a herbicide affects absorptivity (binding to soil) and water solubility.
  - Herbicides highly bound to soil particles are often less likely to be available for microbial degradation.
- **Moisture**
  - Moisture enables herbicide to be in the soil solution
  - Soil microbes are most active under moist but not saturated condition
  - Herbicide adsorption (binding) is greater under dry conditions
- **Temperature**
  - Optimum soil microbial activity occurs in June, July and August when temperatures range from 70F to 85F.
  - Less breakdown before June or after August or when soil temps are less than 50F
- **Soils**
  - CEC, especially organic matter
  - Soil pH

# The choice of crop to plant following a specific herbicide application the previous year can greatly influence injury potential because crops differ in their susceptibility to herbicides.

- The crop rotation restrictions for residual herbicides is the period of time between herbicide application and when a sensitive crop can be planted under normal environmental conditions.
- Crop rotation restrictions may need to be extended by an additional season and/or a more tolerant crop seeded under drier conditions or when June 1 to September 1 rainfall is less than 6-inch.
- Additional information and a complete list of crop rotation restrictions for herbicides is found on page(s) 6 and 100 to 104 in the 2022 North Dakota Weed Control Guide.

# Carryover risk. Risk might be greater in drought conditions.

| MOA/ Family | Trade Name | Common Name | Primary Dissipation Mode | Risk of Carryover Injury season following application to: | | |
|---|---|---|---|---|---|---|
| | | | | Corn | Soybean | Sugarbeet |
| Auxin | Stinger | clopyralid | Microbial | - | Moderate | - |
| ALS | Pursuit | imazethapyr | Microbial | Moderate | - | High |
| HPPD | Callisto | mesotrione | Microbial | - | Very low | High |
| HPPD | Laudis | tembotrione | Microbial | - | Low | High |
| PPO | Authority | sulfentrazone | Microbial | Low | - | High |
| PPO | FlexStar | fomesafen | Microbial | Moderate | - | High |
| PPO | Sharpen | saflufenacil | Microbial | - | Low | Low |
| PPO | Valor | flumioxazin | Microbial | Low | - | Moderate |
| PSII | Aatrex | atrazine | Microbial | - | High | High |
| PSII | Sencor | metribuzin | Microbial | Low | - | High |

# Group 27 herbicides, HPPD

- Group 27 herbicides interfere with pigment production and production of chlorophyll.
- Chlorophyll production is inhibited, and plant foliage turns white and appears bleached.
- Corn is tolerant to group 27 herbicides such as Callisto and Laudis due to rapid metabolism.

# Laudis carryover to sugar beet

# Group 14 herbicides, PPO Inhibitors

- Herbicides are activated by exposure to sunlight to form oxygen compounds that destroy plant tissue
- Destruction results in rapid necrosis
- Soil applied (Valor, Authority) or POST (Flexstar, Cobra)

# Valor Carryover in sugarbeet

# Group 5 Herbicides – PS II Inhibitors

- Inhibit Photo System II in the plant.
- Examples are atrazine and metribuzin (Sencor).
- Sugar beets often will emerge, then older leaves begin to burn back.
- Soil pH effects

# Atrazine carryover in sugarbeet

Older leaves burned off these plants

Burning of older leaves

# Group 2 Herbicides – ALS Inhibitors

- Inhibit action of acetolactate (ALS) enzyme in plant
- Some herbicides in this family have long soil residuals
- Imazethapyr (Pursuit)
  - Generic products and premixes contain this active ingredient
- Breakdown is very dependent on soil pH
  - Specific to product – read label for information

# Imazethapyr (Pursuit) carryover to sugarbeet

36 months after application

48 months after application

# Group 4 herbicides and carryover to soybean

- Products in small grains, corn, and sugarbeet contain clopyralid (Stinger in sugarbeet).
- Stinger degradation is by microbes; application rate, soil texture, moisture and temperature affect rate of Stinger degradation/carryover.
- Stunting and stacked soybean nodes
- Soybean injury is erratic in fields; plant to plant variation or pockets of heavy damage
- Soil residues of Stinger do not cause the uniform distortion of leaves associated with drift of 2,4-D or dicamba.

# Stinger carryover to soybean

# Stinger carryover to soybean

# Assessing herbicide residues in soil

- Evaluate carryover risk based on rainfall from June 1 to September 1.
- There is very low correlation between the concentrations of an active ingredient in a soil test and crop injury response due to field variation.
- Plant bioassays can also be conducted by growing a sensitive rotational crop in soil from a field with suspected residues. Result may be unreliable due to field variability.
- Analysis is compromised if soil is sampled too deep, diluting residues and increasing the risk of a false negative.
- Samples should be collected from the top two inches of soil.

# Summary

- Extended drought may increase potential for herbicide carryover to crops planted in sequence
- Carryover injury depends on the herbicide concentration in the soil and the susceptibility of the intended rotational crop to that herbicide.
- Most herbicides primarily degrade by soil microbial processes, which are reduced by dry conditions.
- While growers cannot do much to change the concentration of herbicides present in the soil, they can do several things to reduce the risk of carryover injury.