Understanding Herbicide Injury in Vegetable Crops and Labels

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Outline for Presentation

• Types and requirements for various herbicide labels
• Types of Herbicide Injury and cause
• How to minimize potential
• Factors to consider regarding causes
• Herbicide Types and Injury Symptoms on Vegetables
• What can be done when injury occurs
  • Check list to follow
  • Is replanting an option?
  • People to contact
• Future Concerns in Herbicide technologies in Agronomic Crops
Pesticide Label Types

- Section 3 – Full Federal Label for a pesticide
  http://www.cdms.net/Label-Database

- Section 18 - Section 18 of FIFRA (the federal law which regulates pesticides) authorizes the Environmental Protection Agency (EPA) to exempt State agencies (MDARD) from federal registration requirements if it is determined that "emergency" conditions exist which require an exemption. An emergency condition is an urgent, non-routine situation which will result in dire consequences if the exemption is not granted. Section 18 exemptions primarily allow the use of a pesticide on a site for which it is not federally registered.

- Approved for 1 year and can be reapplied for but company movement toward registration is expected in future
24(c) Labels

• 24(c) Special Local Needs [Pesticide] Labels - Under the authority section 24(c) of FIFRA, states may register additional uses of a federally registered pesticide to meet "special local needs" as long as there is a demonstrated "special local need" and a tolerance, exemption from a tolerance, or other clearance under the Federal Food Drug and Cosmetic Act

• Companies are often now requiring growers to sign waiver of liability before such chemicals can be used

• Examples: Reflex in melons in MI and IL

• Some states do not approve of the waiver of liability requirement
Third Party Registrations (TPR)

• A Third Party Group - Registers a chemical that would not be available to growers otherwise because company has a limited return and a high liability with the chemical.

• Such labels are unlike any other in the country and before label approval, they must go through an authorization and approval process with the manufacturer, producers who grow the crop, the State Regulatory Organization and the U.S. Environmental Protection Agency.

• Once approved, the label is managed by the third party through requirement of grower signing of a waiver and limitations of warranty and liability process.

• The potential crop damage or non-performance liability to the registrant make these products too risky for a typical manufacturer labeling process. The TPR system provides protection to the pesticide manufacturer and distributor for this crop damage and non-performance liability in return for the right to register the product for a particular need.

• All TPR labels are Special Local Need 24(c) registrations that are specific to and allowable for use only in the approving state.

• These labels are not easily obtained and are few in number nationally
Third Party Registrations (TPR) - Examples

• CHATEAU® Herbicide WDG
  For pre-emergence and post-emergence weed control between rows of transplanted or seeded fruiting vegetable crops, okra and cucurbit vegetable crops grown using the raised-bed plastic mulch production system in FL.

• Dual Magnum and Chateau
  GFVGA holds third party labels for giving GFVGA members an alternative to controlling weeds in plasticulture beds.

We are in discussions with the OISC about 24(c) labels and the requirement for growers to sign a waiver of liability with the chemical company registrant. So far, the problem is the company refusal to not require a waiver of liability. There is some information to suggest this is not allowed by EPA rules and is under continuing discussion. STAY TUNED!
Determining Type of Herbicide Injury and Cause

• The key is to determine when the injury symptoms first became evident.

• Symptoms that appear during or immediately after crop emergence may indicate carry-over or preemergence herbicide damage.

• Injury symptoms appearing after crop emergence points to a postemergence herbicide.

• The second key is to determine if the injury was the result of a herbicide with contact activity or if the herbicide was translocated in the plant.
  • A contact herbicide affects leaves that were present at time of contact.
  • A translocated herbicide affects new leaves.

• The final step in the key is to match the injury symptom to a herbicide mode of action.
Potential Causes of Injury During or Immediately after Crop Emergence

- Herbicide carry-over
- Misapplication- rate too high
- Shallow seed placement
- Wrong herbicide rate for soil type
- Improper interval between herbicide application and planting
- Excessive rainfall and cold soils
- Improper herbicide placement or timing
Injury After Crop Emergence – Potential Causes

- **Drift**
  - More than one type of plant is affected
  - Symptoms appear only on one portion of the plant or plants
  - Other causes of damage have been ruled out, (such as nutrient deficiencies, air pollution, insects, diseases or virus)

- Tank contamination
- Misapplication- rate too high
- Incorrect additive/surfactant
- High temperatures/humidity at application
- Improper tankmix partner
- Wrong herbicide
Most Herbicide Drift and Carryover can be attributed to 6 classes of herbicides

Triazines – Atrazine, Simazine, Metribuzin

ALS Inhibitors - Classic, Resolve, Cimarron, Permit, Pursuit, Scepter, and Python

AA Acid Inhibitors – Glyphosate (Roundup)

Growth Regulators – 2,4-D and dicamba

Pigment Inhibitors - Lumax, Lexar, Balance, Corvus, Callisto, Impact, and Laudis, Clomazone

Protox Inhibitors - Reflex, Flexstar, Authority, Spartan, Valor/Chateau
Triazines are photosynthesis-inhibiting herbicides that block the photosynthetic process and affected plants slowly dies.

• **Carryover** - In broadleaved plants, early seedling growth appears normal, but shortly after emergence leaves become mottled, turn yellow to brown, and die. In most cases, the *oldest leaves turn yellow on the leaf margins first*, the veins remain green, and eventually the plant turns brown and **dies**.

• **Drift** – Impacted leaves show contact injury, initially yellow then brown but herbicides do not move through the plant. Unless there is total coverage from drift the plants usually will not die.

• **Herbicides** such as atrazine, simazine, metribuzin, and Velpar could cause this kind of injury.
Triazine Injury Symptoms

Atrazine carryover injury

Sencor injury can occur in cool, cloudy conditions and high pH (>7.8) soils.
Triazine Injury from Carryover

- Younger leaves show less injury
- Inter-veinal chlorosis
- Burning of leaf margin
ALS Inhibitors - Classic, Resolve, Cimarron, Permit, Pursuit, Scepter, and Python

• Can be a carryover or drift problem
• These herbicides interfering with key enzymes in the production of specific amino acids in the plant that shut down the plant’s metabolic processes causing plant death.
• Sensitive plants sensitive stop growth almost immediately after foliar treatment; seedlings die in three to seven days, established perennials in two to four weeks.
• Symptoms include: stunted, yellow, purple veins, dead growing point, roots malformed (bottle-brush).
• These herbicides have systemic activity and young leaves are affected first.
ALS Inhibitors - Classic, Resolve, Cimarron, Permit, Pursuit, Scepter, and Python

- Carryover – bottle brush roots, malformed leaves, stacked buds
ALS Inhibitors - Classic, Resolve, Cimarron, Permit, Pursuit, Scepter, and Python

- Drift – bean interveinal reddening, summer squash and cucumber leaf and bud injury
AA Acid Inhibitors – Glyphosate (Roundup)

• Plant foliage, especially new growth, will first yellow and then turn brown and die within a week or so after herbicide application.

• Sometimes new leaves exhibit a bright yellow or even white appearance which can be confused with injury from other herbicide groups.

• Leaves can be malformed and misshappened and epinasty can occur and sometimes has a dark green almost glossy color.

• Buds can be clumped like callus growth.
AA Acid Inhibitors – Glyphosate (Roundup)
Growth Regulators – 2,4-D and dicamba

- PGR damage does not occur from carryover but from herbicides sprayed in adjacent fields that drift or volatilize.
- Broadleaved plants most susceptible.
- PGRs upset normal growth in cells of leaf veins and affect dividing and elongating leaves and shoots.
- Treated plants become brittle and easily broken.
- Roots quit functioning.
- Symptoms: broadleaf plant leaves become cupped, crinkled, puckered, strap-shaped, stunted, and malformed; leaf veins appear parallel rather than netted, and stems become bent, twisted, and brittle, callused, with shortened internodes.
- Grass crops can be affected depending on stage of growth at time of injury.
Growth Regulators – 2,4-D and dicamba
Dicamba and dicamba + glyphosate

- Dicamba injury 7 DAT
- 1/300x of dicamba + glyphosate
- 1/100 of dicamba + glyphosate
Growth Regulators – 2,4 –D and dicamba
Pigment Inhibitors - Lumax, Lexar, Balance, Corvus, Callisto, Impact, and Laudis.

Clomazone

• These products are referred to as “bleachers” since they interfere with normal chlorophyll formation.

• Symptoms are very evident and easy to identify.

• Effected plants turn white or show bleached leaves, and eventually die if concentration of herbicide is high enough.
Pigment Inhibitors - Lumax, Lexar, Balance, Corvus, Callisto, Impact, and Laudis. Clomazone
Clomazone Drift onto roadside Vegetation
Protox Inhibitors - Reflex, Flexstar, Authority, (Spartan), Valor(Chateau)

- Reflex and Flexstar are generally considered contact herbicides and kill weeds by destroying cell membranes. Soil active herbicides Authority and Valor kill by the same method but are not generally a drift problem.
- Plant tissues are burnt within hours or days of application.
- Good coverage of the plant tissue and bright sunlight are necessary for maximum activity.
- Effected plants initially have a “water soaked” appearance, followed by rapid wilting and “burning,” or leaf speckling and browning. Plant death occurs within a few days.
- Some of the PPO-inhibitors have longer soil residual activity so potential carryover is a concern especially Reflex on corn.
Protox Inhibitors - Reflex, Flexstar, Aim, Authority, (Spartan), Valor(Chateau)

Aim injury on corn

Reflex carryover on corn
What to Do
If Injury Occurs from Drift (similar for carryover)

• Preliminary Herbicide Drift Diagnosis

• Investigating starts when unusual symptoms on crops are observed or if nearby spraying has occurred during weather conditions that may cause drift. Look for symptom patterns in the field and document the severity of symptoms.

• Check list of actions

• Is there a symptom-intensity gradient across the field?
• Patterns of injury may help identify the source of the problem.
• The direction of herbicide drift can sometimes be determined by finding "drift shadows" by trees, buildings, or elevated roads. Anything that intercepts or deflects spray droplets can cause an area of undamaged plants on the downwind side of the object.
What to Do if Injury Occurs from Carryover and Drift (continued)

- Check if other species, especially weeds, develop symptoms similar to symptoms on the crop.
- If there is open ground or a crop between the damaged field and the sprayed field and if so, check for herbicide symptoms on plants in that area.
- Draw a map or use GPS to locate injured plants in the field and record the date when injury symptoms were first observed.
- Write a description of injury symptoms and photograph typical symptoms of foliage, roots, and bio-indicator plants such as weeds and continue through the growing season.
- Take many quality photos including close-up photos by date and location. Aerial photos may help to show the pattern and severity of herbicide damage.
What to Do if Injury Occurs from Carryover and Drift (continued)

• Create a timeline of the drift incident by investigating all events in the surrounding area.

• Drift is most likely from adjacent areas but also may occur from farther away.

• Try to determine the date and time of herbicide application, herbicide name and formulation, wind speed and direction, temperature during application, name of applicator, boom height, nozzle type, spray pressure and gallons per acre.

• Collect and record the crop and herbicide history of damaged fields to prove that damage is not due to your own spray.
What to Do if Injury Occurs from Carryover and Drift (continued)

- Plant tissue and soil can be analyzed for herbicide residue. However, growers need to take several precautions when analyzing tissue or soil:
  - Select a reputable laboratory that is certified to conduct GLP (good laboratory practices) analysis.
  - Sample plant tissue or soil from areas where symptoms are intense. The depth of soil sample is important for herbicide detection ~ 3-4”.
  - Plant tissue or soil samples should be packed in dry ice and sent to the lab immediately after sampling and should be analyzed immediately.
  - Chemical analysis is costly and may not provide a positive identification of some of the herbicides that damage plants because detection levels are not high enough.
  - Chemical analysis may determine the presence of herbicide residue but cannot determine the source of drift or any yield loss caused.
What to Do if Injury Occurs from Carryover and Drift (continued)

• Contact the County Agent immediately after observing herbicide injury symptoms to file an official complaint and arrange for their visit or visit by OISC to your field.

• Try to estimate the extent of yield loss. EARLY SYMPTOMS ARE NOT A GOOD INDICATOR OF YIELD LOSS. Crops frequently recover from slight to moderate symptoms and may yield similar to unaffected fields. Actual yield loss generally is less than expected from early season observed herbicide symptoms.

• The best method to estimate yield loss is to compare the yield from damaged areas to the yield of plants that do not show any herbicide injury symptoms.

• Comparison of yields between years is not reliable because yields fluctuate between years. But, historical yield data will help substantiate normal production levels.
Avoid Herbicide Soil Carryover Problems

- Know field history including herbicides used in past, amount, time applied and crops grown
- Read labels of previous herbicides to know replant restrictions and follow – if not you are at risk if injury occurs
- If unsure, take soil sample and run a bioassay and possibly send to a lab for analysis
- Soil bioassay
  - Take a representative soil sample from field going to root depth
  - Put soil in a pot and grow your target plant
  - Compare growth with plants grown in a clean soil for size, leaf development and root health
What do I do with an injured crop?

• Do I Replant?
• Do I Harvest Crop?

• Good Questions and it depends on timing and the herbicide in question.
• Carryover – usually only replant to a tolerant crop
• Drift – if early in season and damage severe, replant not an option
• Drift – If damage not severe, usually will keep crop and harvest
  Problem arises if there are herbicide residues in harvested crop
Precautions to Take to Minimize Drift Potential

• Register on Driftwatch - https://driftwatch.org/

• Communication with neighbors

• Label Fields

• OISC - http://www.oisc.purdue.edu/
Future Concerns

• Dicamba resistant Soybeans will be on market in 2017
  • Roundup Ready2 Xtend Soybeans
  • Engenia for Xtend crops from Monsanto
  • Both will allow use of newer dicamba formulations and glyphosate for weed control
  • Be aware of whether your neighbors plan on growing such soybeans if you are growing any vegetable crop

• 2,4-D resistant corn and soybeans possibly by 2018
  • This technology will be called Enlist and with allow 2,4-D and glyphosate use in corn and soybeans