

LECTURE - 13: Herbicide Injury & Injury Diagnosis

Major topics to be discussed:

- Types of crop losses
- How plants tolerate herbicides
- Factors associated with crop injury
- Check list for injury diagnosis



A. Types of crop loses

1. Crop loses due natural causes:

- a) Drought**
- b) freezing (MI-Spartan garden frost incidence)**
- c) lightening**
- d) wind**
- e) acid rain or air pollution from volcanic activity**



2. Crop losses due biotic factors:

- a) insects and diseases (broad mites similar to phenoxy)
- b) nematodes



A. Types of crop losses

3. Crop losses due to human influences:

- a) nutrient deficiencies or excesses (Kahuku, low pH due to fertilizer cause Mn deficiency)**



3. Crop losses due to human influences:

- b) Air pollution, ozone/PAN mention NJ. Experience
- c) water logging or hardpans caused by compaction with heavy equipment and plowing
- d) Crop injury from herbicides



A. Types of crop losses

3. Crop losses due to human influences:

(1) Easiest to blame herbicides most costly to chemical companies and eventually growers and consumers.

(2) herbicide injury in the field often displays a pattern:

(a) drift with gradients oriented toward prevailing winds

(b) injury at the ends of fields due to slowing tractor with spray boom on, also around obstacles like trees and rocks around golf courses

(c) injury at the top of hills due to tractor slowing with boom on

Symptoms can follow some general characteristic, based on specific herbicide used, consult books on herbicides or web sites on activity to obtain this information.

University of Florida Web site <http://edis.ifas.ufl.edu/ag337> Diagnosing Herbicide Injury in Peanuts)

A history of the site where injury is reported is important in conclusions made about the cause of injury, consider herbicide carryover.



A. Types of crop losses

3. Crop losses due to human influences:

(1) Easiest to blame herbicides most costly to chemical companies and eventually growers and consumers.

(2) herbicide injury in the field often displays a pattern:

(d) Strips due to problem with boom, too low with over application under nozzles or too high with too much chemical between nozzles.

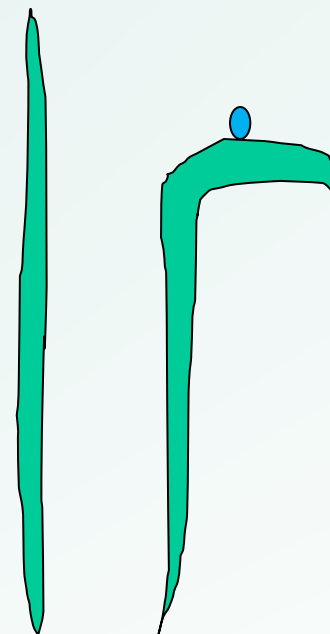


A. HOW DO CROPS TOLERATE HERBICIDES, TOLERANCE FAILURE CAN LEAD TO INJURY.

1. Selectivity from DIFFERENTIAL WETTING, e.g. onions with sulfuric acid, (draw upright onion and onion at the "flag stage").

a) Sulfuric acid was commonly used in onions (did not penetrate onion cuticle also upright leaves added in run off), include picture of broadleaf weed with hair to stop herbicide spray drop.

b) same principle with dinoseb (PREMERGE) IN PEAS



A. HOW DO CROPS TOLERATE HERBICIDES, TOLERANCE FAILURE CAN LEAD TO INJURY.

2. Selectivity by HERBICIDE PLACEMENT.

- a) Simazine (PRINCEP) and diuron (KARMEX), little movement through soil profile, thus shallow rooted weeds killed and deeper-rooted crops are safe (*draw e.g. of orchard setting with roots below herbicide layer*)**
- b) Injury when herbicide gets into planting hole can occur when residual soil herbicides applied before tree planting.**
- c) Seeds can germinate rapidly and move through herbicide barrier at the soil surface. Cool wet weather can slow germination and result in injury. Seedling shoots remain in herbicide zone too long.**



A. HOW DO CROPS TOLERATE HERBICIDES, TOLERANCE FAILURE CAN LEAD TO INJURY.

3. Selectivity by true PHYSIOLOGICAL RESISTANCE

a) Involves plants converting the herbicide to a non-toxic form or failing to translocate the herbicide. This ability can be reduced by adverse weather conditions or plant stress brought on by drought or nutrient problems.

4. Understanding the nature of the herbicide action and selectivity will aid in making the correct conclusion about its role in a plant response, with regard to herbicide injury diagnosis.



HERBICIDE INJURY, CONSIDERATION TOWARDS PREVENTION

A. *HEAD AND READ*

1. Most errors occur at the time of application
2. Single most important step to avoid injury is to READ THE LABELS AND HEAD THE WARNINGS

a) Cautions deal with:

- (1) rates of application
- (2) methods of application
- (3) chemical selectivity (note cultivar differences for crops like corn and potato, with new varieties be careful and treat a small area first)

b) Labels are legal documents, constituting a claim for performance and a use disclaimer for misapplication. (When answering calls, ask what label directions said with regards to spray applicators complaints; avoid the courts at all costs.)

c) Labels discuss injury potential to fish and wildlife, never dispose of wastes in drainage ditches or where it can be washed into crop lands (Discuss Kauai example of diuron in taro patch, draw injury pattern)



IS APPLICATION EQUIPMENT WORKING PROPERLY?

1. Herbicide applicators are designed to apply chemicals uniformly over the surface of a given area. Problems that cause a lack of uniformity can lead to injury symptoms.

- a) **Lack of uniformity is contributed by changes in on tractor speed, pressure, nozzle size and amount of chemical added to carrier liquid (water)**
- b) **Use of orchard guns to deliver preemergence herbicide, e.g. Goal on soil in ginger production.**

2. Equipment should be calibrated periodically to assure proper delivery rate, nozzle wear (particularly brass) could change output of nozzles and lead to overdosing. Roundup can quickly wear out brass tips.

Proper spray agitation is essential when applying wettable powders or very thick slurries.

If not operating properly, herbicide settles in the tank and overdosing occurs at the start of spray while under dosing at the end of spraying. This order can be reversed when pumps sucks up materials not properly mixed, **e.g. Aiea ball field clean up.**



A. SOIL CARRY-OVER PROBLEMS

1. Residues of persistent herbicides can cause problems in the next crop if susceptible to the herbicides. Herbicides persist in the following situations
 - a) **Cool moist conditions**
 - b) **Drought and lack of microbial activity (Work by Nishimoto in pine field indicated that moisture alone was a very important ingredient in reducing herbicide toxicity in fields, dry conditions will extend herbicide persistence.**
2. Carry over is prevented by reducing rates of application or by selecting herbicides with short soil life spans.
 - a) **With corn, a Lasso/Bladex mixture to reduce carry over problems can replace atrazine.**



A. AVOID INCOMPATIBLE MIXTURES AND SPRAYER SYSTEM CONTAMINATION

1. Use separate sprayers for herbicides and other pesticide sprayers. Failure to clean out herbicides can cause injury.
2. Herbicides are generally applied in mixtures to increase the spectrum of weeds controlled. Check label precautions to make sure mixtures are compatible. Problems, which arise from using unlabeled herbicide mixtures, are not the responsibility of the manufacture.
3. Mixtures can cause problems with synergisms or antagonisms
 - a) **SYNERGISM**, materials exert a greater effect as a mixture than the sum of the individual components. E.g. is the effect of surfactants or wetting agents, either one alone cause less injury than the mixture of the two. Some herbicides have solvents to aid in mixing with water, with a post spray those solvent may increase activity to the point of removing the selective nature of the spray. (*e.g. mix of Goal and Gramoxone more toxic than sprayed alone*)
 - b) **ANTAGONISMS** occur when a mix of herbicides is applied and the action of one or both is reduced, e.g. glyphosate (systemic in nature) and oxyfluorfen (has contact activity and preemergence control). Foliage injury due to Goal reduces Round-Up activity on perennials.



WEATHER AS A FACTOR ON HERBICIDE INJURY

1. Adverse weather is the biggest single factor in enhancing herbicide injury. Injury increases when crops are under stress.

- a) **Cool wet conditions cause injury with pre herbicides, crop growth is slow and shoots remain in the herbicide zone too long, e.g. beans when using alachlor (Lasso).**
- b) **Humid, cloudy conditions reduce leaf wax and thus enhance uptake of postemergence herbicides; shade in landscapes can cause a mixed response to herbicides within the same plant species.**
- c) **Hot humid conditions enhance leaf scorch of post chemicals, humid conditions are conducive to foliar uptake because chemical remain in liquid state longer. Heat load coupled with chemical stress on transpiration increases foliar injury. Major consideration when applying chemicals to golf greens.**



DIAGNOSIS OF HERBICIDE INJURY

A. TIME IS CRITICAL

1. As a grower, injury claims should be reported as soon as possible, difficult to determine injury when examining dead and dry plants, photos of developing crop injury important too, one snap shot may not tell the complete story.
2. If plants or soil is to be chemically analyzed, samples should be frozen as soon as possible after removing from the field and kept that way until brought into the lab.

People associate herbicide injury with a single event instead a series or combination of events. Many will note the occurrence of plane flyby or road crew spaying weeds or funny smells after lawn care maintenance



DIAGNOSIS OF HERBICIDE INJURY

DON'T MAKE SNAP JUDGMENTS OVER THE PHONE OR IN PERSON

1. Symptoms may overlap or appear similar to many other problems, once you tell some one it is herbicide injury you will never change their minds to something else. Don't draw conclusions until all facts are in, you may have to backup your conclusions in court.
2. Ask as many questions as possible; ideally allow the applicator to arrive at the solution to the problem themselves.

A logical conclusion to injury problems may not be possible, do not suggest possible causes. You may be asked to rank them in order of probability in court based on your analysis of the problem. Better to state that no logical cause exists or more information is needed.









If you were asked what is causing this pattern of dead and living plants, what questions would you ask?



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DIAGNOSIS OF HERBICIDE INJURY

A. WHAT QUESTIONS TO ASK

1. What herbicide(s) used in this crop, what was the previous crop?
2. How much chemical was added to spray tank last time you sprayed?
3. What other chemicals used in tank or on same crop, timing of two sprays?
4. When was the sprayer last calibrated, GPA, by who, method of calibration?
5. What nozzles (then inspect), speeds, pressure of spray?
6. Dates of planting, spraying, weather data if available.
7. What stage of crop when sprayed, see label for safety window of application.
8. What crop variety?
9. Are soil test available, pH, nutrient status, and indication of imposed stress?
10. Seed treatment, either on the seed or in the row, placement and how much.



DIAGNOSIS OF HERBICIDE INJURY

A. LOOK FOR THESE THINGS IN THE FIELD

1. Injury bands (draw field patterns)
2. Is injury band the same as spray boom width
3. Do injury symptoms change with soil type or organic matter in the same field
4. Injury in patterns
 - a) **washings down hill**
 - b) **at the ends of fields**
 - c) **note field edges such as forests, gulches windbreaks**
5. Drift pattern, check prevailing wind direction, note gradient in activity
6. Look at non-treated area in adjacent field to compare injury.
7. Check symptoms of susceptible weeds and compare with crop injury, e.g. Apple of Peru around tomato fields, both in the same plant family.
8. Obvious symptoms of insect damage, diseases, wind, hail.
9. Inspect equipment for defects, matching nozzles, uniformity of output along the boom.
10. Poor agitation in spray tank, mention siphon bucket used by orchid growers.
11. Improper nozzle spacing



A. WATCH FOR LOOK-ALIKE

1. Soil borne diseases resemble those caused by pre herbicides, similar symptoms when stems collapse at the soil line. Timing of diagnosis important so that secondary invaders do not confuse the situation.
2. Leaf abnormalities caused by phenoxy herbicides looks similar to viruses. Insects cause leaf abnormalities by transmitting viruses. (*e.g. nose mites in lychee*)
3. Leaf abnormalities caused by nutrient deficiencies, interveinal chlorosis by triazines similar to manganese or iron deficiencies.
4. Certain pesticides carry solvents that can appear as herbicide injury. Papaya very sensitive to emulsifiable concentrates



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SIMAZINE



Photosynthesis inhibitors, blocks PS, energy builds and kills cells



ATRAZINE



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Univers



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Paraquat, block PS,
forms O_3 and breaks
membranes in
chloroplast



Chloroacetamides: lipid and protein synthesis



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The growth regulator herbicides bind to auxin receptors within the plant, mimicking natural auxin. Causes rapid and uncontrolled cell division and growth



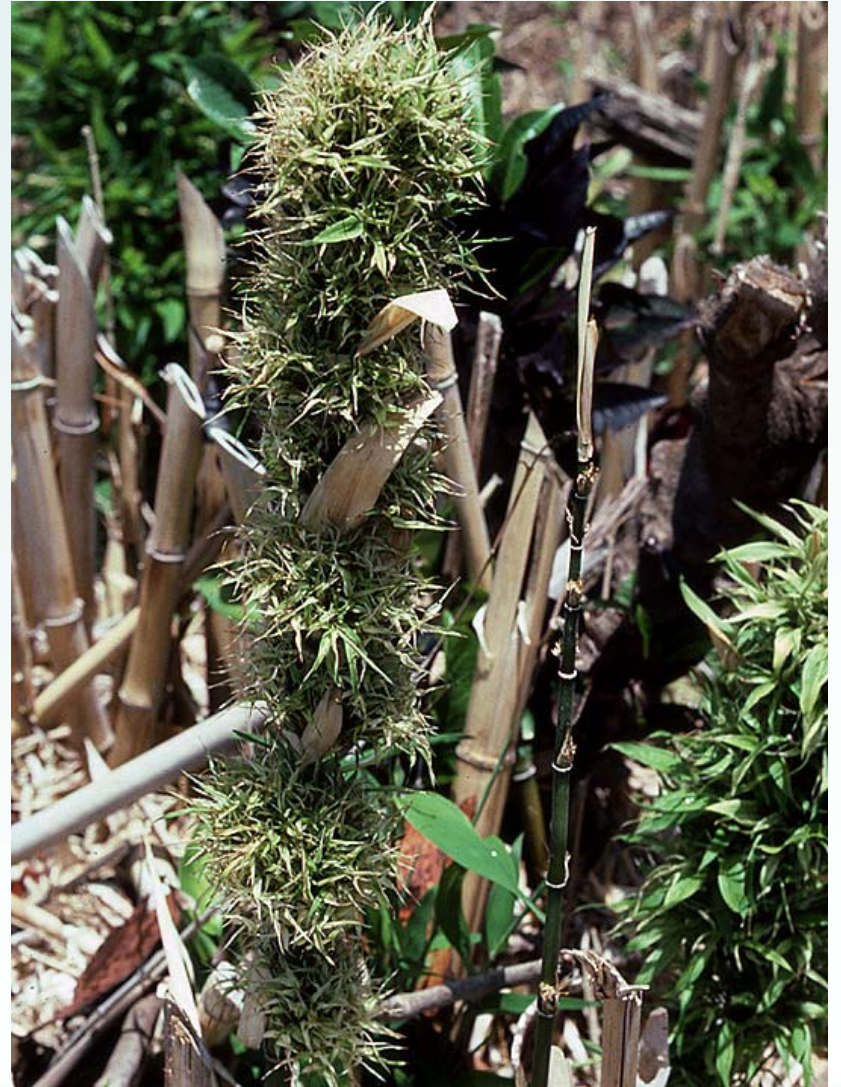
Dicamba in combo with fertilizer



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Glyphosate injury



negative geotropism

naptalam



trifluralin



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PHENOXY



2,4-D on tomatoes



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Imazapyr – trade names = Arsenal, Habitat & Polaris





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Norflurazon on ginger
& peanut – leaf
bleaching



Review handouts on Injury Diagnosis Check List

