SCS-1999-05

Texas Agricultural Extension Service
The Texas A&M University System

# PEANUT HERBICIDE INJURY SYMPTOMOLOGY GUIDE

***Edited By***
**Eric P. Prostko**, Assistant Professor and Extension Agronomist - Stephenville
**Todd A. Baughman**, Assistant Professor and Extension Agronomist - Vernon

***Contributors***
**Paul A. Baumann**, Associate Professor and Extension Weed Specialist - College Station
**Peter A. Dotray**, Assistant Professor and Extension Weed Specialist - Lubbock
**W. James Grichar**, Research Scientist - Yoakum
**Thomas A. "Chip" Lee**, Professor and Extension Plant Pathologist - Stephenville
**Robert G. Lemon**, Associate Professor and Extension Agronomist - College Station

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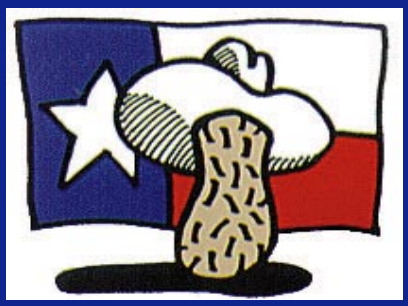


***Printing of this publication was made possible through a grant provided by the Texas Peanut Producers’ Board***

# Introduction

Over the past few years, peanut production in Texas has rapidly increased in various regions of the state. Consequently, Texas is now ranked second in U.S. peanut production. Since production has expanded into regions of the state that historically have not grown this unique crop, new growers may be unfamiliar with the many problems that can occur in peanut. Advances in management systems have also challenged experienced growers to remain up-to-date in their production knowledge.

Herbicide injury is a common problem that can occur in peanut. Since other types of problems (i.e., insects, diseases, soil nutrient deficiencies/ toxicities, and environmental stresses) can produce similar types of symptomology, the diagnosis of herbicide damage is often difficult to assess. The objective of this publication is to provide producers, consultants, county agents, extension specialists, and other persons interested in peanut production with a pictorial reference guide of peanut injury symptoms resulting from herbicide applications.

# Causes of Herbicide Injury

In the diagnosis of herbicide injury, it is very important to understand the potential causes of the injury. The following is a list of these potential causes:

1. Spray-tank contamination
2. Improper sprayer calibration
3. Excessive herbicide rate for crop or soil type
4. Improper herbicide application timing or method
5. Failure to adhere to crop rotation restrictions
6. Interaction with other pesticides or spray additives
7. Application of herbicide to crop under stress
8. Off-target drift of herbicides labeled for use in other crops
9. Small concentration of herbicides in irrigation water
10. Normal herbicide symptomology

# Herbicide Mode of Action

In this guide, we have chosen to classify herbicides by their mode of action. The term mode of action refers to the overall sum of the biochemical processes that result in plant death. Classification by mode of action is critical to the identification of herbicide related injury problems. In many cases, herbicides with the same mode of action will produce similar types of injury symptoms.

The herbicides most commonly used in Texas can be placed into seven mode of action categories. These include the following: growth regulators, photosynthesis inhibitors, pigment inhibitors, seedling growth inhibitors, cell membrane disruptors/ organic arsenicals, lipid synthesis inhibitors, and amino acid synthesis inhibitors. For additional information about these modes of action, refer to the Texas A&M University, Department of Soil & Crop Sciences publication SCS-1998-07: Herbicide Mode of Action and Injury Symptomology.

# Herbicide Injury Symptoms

## Growth Regulators

Herbicides with this mode of action are primarily used to control broadleaf weeds in grass crops. When applied to broadleaf plants, they affect several processes such as cell division, cell enlargement, protein synthesis, and respiration. Because of their unusual effects on plants, they are often referred to as the “hormone herbicides or phenoxies”. Generally, these herbicides are applied postemergence but have preemergence activity on sensitive plants.

*2,4-DB leaf strapping*

Specific herbicides with this mode of action include 2,4-D, 2,4-DB, Banvel /Clarity (dicamba), Reclaim (clopyralid), Remedy (triclopyr), and Tordon (picloram). Several tank-mix combinations of these herbicides are commonly used in pastures including Weedmaster (2,4-D + dicamba) and Grazon P + D (2,4-D + picloram). Typical injury symptoms of these herbicides include stem curling/ twisting and leaf cupping/crinkling. When applications are made at excessive or above labeled rates to peanut plants that are beginning to set pods, they can also cause severe malformations of the pods.

*Grazon P+D carryover*

## *Photosynthesis Inhibitors*

*Marginal chlorosis*

Herbicides with this mode of action disrupt the vital process of photosynthesis which is the method that all green plants use to convert light energy from the sun into food. Photosynthesis inhibiting herbicides are used in many different crops to control annual grasses and broadleaf weeds. Depending upon the herbicide, they can be applied preemergence, postemergence, or both. Many herbicides used in Texas have this mode of action including Aatrex (atrazine), Basagran (bentazon), Bladex/Cy-Pro (cyanazine), Buctril (bromoxynil), Caparol/Cotton-Pro (prometryn), Cotoran/Meturon (fluometuron), Karmex/Direx (diuron), Lexone/Sencor (metribuzin), Spike (tebuthiuron), Tough (pyridate), and Velpar (hexazinone). Preemergence activity or carryover injury symptoms include yellowing between the veins (*interveinal chlorosis*), yellowing within the veins (*intraveinal chlorosis*), and/ or yellowing of the leaf margins (*marginal chlorosis*) that eventually turns brown and dies (*marginal necrosis*). Injury symptoms from postemergence applications include leaf yellowing, bronzing, speckling, spotting, and burning. Of all the herbicides mentioned in this category, Tough is the least likely to cause peanut injury.

*Buctril damage*

*Basagran injury*

## *Pigment Inhibitors*

Pigment inhibitors affect plants by preventing the formation of the green pigments (*chlorophyll*) found in leaf tissue. Without chlorophyll, the process of photosynthesis is inhibited which ultimately leads to plant death. These herbicides are applied preplant incorporated or preemergence in broadleaf crops

*Command*

for the control of grass weeds and certain broadleaf weeds (cocklebur, spurred anoda, and velvetleaf).

Herbicides with this mode of action include Command (clomazone) and Zorial (norflurazon). A new corn herbicide, Balance (isoxaflutole), has a similar mode of action. The characteristic injury symptom of these herbicides is the development of white foliage or albino growth. Zorial will cause bleaching inside the veins (*intraveinal*) while Command will cause bleaching between the veins (*interveinal*). Because of these effects, Command and Zorial are often referred to as the "bleaching herbicides". Zorial is labeled for use in peanut but is not recommended in Texas because of the potential injury that can occur.

*Zorial*

## *Seedling Growth Inhibitors*

The herbicides with this mode of action that are used in peanut are applied preplant incorporated or preemergence for the control of annual grasses, certain small-seeded broadleaf weeds, and yellow nutsedge (*Cyperus esculentus*).

Herbicides classified as seedling growth inhibitors can be divided into two groups (1) root inhibitors, and (2) shoot inhibitors.

Root inhibitors affect plants by interrupting cell division which severely limits root growth. Herbicides in this group include the class of herbicides known as the "yellows or DNA's" [Prowl (pendimethalin), Sonalan (ethalfluralin), and Treflan (trifluralin)]. The injury symptom most often associated with these herbicides in peanut is a shortened and stubby root system. In severe cases, peg burning can occur. Injury from the DNA's is most often associated with excessive application rates or improper incorporation.

*Root stunting caused by DNA herbicides*

The mode of action of the shoot inhibitors is not well understood but they are believed to disrupt protein synthesis and weaken cell membranes. Herbicides used in peanut that are classified as shoot inhibitors include Dual (metolachlor) and Frontier (dimethenamid). Peanut injury symptoms from shoot inhibitors include leafing out underground, improper leaf unfurling, and stunting. Generally, peanut plants are very tolerant of shoot inhibitors but injury can occur when excessive rates are applied and cool, wet soil conditions exist.

*Shoot inhibitor injury*

## *Cell Membrane Disruptors/Organic Arsenicals*

*Starfire*

Cell membrane disruptor herbicides are used for the postemergence control of many broadleaf and grass weeds. After application, these herbicides destroy plant cell membranes which causes a rapid desiccation of the cell and loss of cell contents. Three herbicides within this group labeled for use in peanut include Blazer (acifluorfen), Starfire (paraquat), and Storm (acifluorfen + bentazon). Since these herbicides are relatively fast-acting, the injury symptoms occur within a short time after application. Typical leaf injury symptoms on peanut include spotting and/or a water-soaked appearance. Although injury from these herbicides is common, research has shown that no significant reductions in peanut yield or grade occur when applied according to the label. For example, the injury potential from Starfire is greatly increased if Starfire is applied later than 28 days after cracking. Other important herbicides in this category, not labeled for use in peanut, include Cobra (lactofen), Diquat, Goal (oxyfluorfen), and Reflex (fomesafen).

*Blazer burn*

The organic arsenicals DSMA and MSMA are used in cotton and turf production systems for the postemergence control of annual grasses, certain broadleaves, and yellow nutsedge. They are not labeled for use in peanut. The exact mode of action of these compounds is not well understood but they are often grouped together with the cell membrane disruptors because of their similar effects on plants. Peanut plants treated with organic arsenicals exhibit leaf burn, especially along the leaf margins.

*MSMA*

## *Lipid Synthesis Inhibitors*

Lipid synthesis inhibitor herbicides are applied postemergence for the control of annual and perennial grass weeds. They have no herbicidal activity on broadleaf plants. Herbicides with this mode of action disrupt the formulation of lipids which are criticial to the formation of cell membranes. Herbicides included in this group that are labeled for use in peanut include Poast/Poast Plus (sethoxydim) and Select (clethodim). The peanut plant is very tolerant of these herbicides and injury from them is almost non-existent. However, these herbicides are applied with a crop oil spray adjuvant. Under certain conditions (i.e., hot and humid), the crop oil can cause injury in the form of a leaf burn or spotting. Symptoms of lipid synthesis inhibitor herbicide injury on susceptible grass plants include yellowing (chlorosis) followed by necrosis (complete tissue death). The meristematic (new growth) region develops a "rotted" appearance which

*Poast Plus + Crop Oil*

*Rotted meristem*

becomes very evident when the leaves are pulled from the whorl of the plant. In some grasses, a reddish-blue pigmentation can be observed.

*Yellowing caused by lipid synthesis inhibitor*

## *Amino Acid Synthesis Inhibitors*

Amino acid synthesis inhibitors are quite unique in terms of their herbicidal properties. They are applied at extremely low use rates, provide control of grasses, broadleaves, sedges, have soil and foliar activity, and are environmentally benign. Amino acid synthesis inhibitors affect plants by inhibiting the formation of specific plant enzymes that are crucial for the formation of amino acids. Without amino acids, proteins cannot be formed and plants cannot grow. There are a number of herbicide families that are classified as amino acid synthesis inhibitors. Some of the more important members of these families that are used regularly in Texas include the herbicides Accent (nicosulfuron), Ally (metsulfuron), Amber (triasulfuron), Arsenal (imazapyr), Beacon (primisulfuron), Cadre (imazapic), Classic (chlorimuron), Glean (chlorsulfuron), Peak (prosulfuron), Permit (halosulfuron), Pursuit (imazethapyr), Scepter (imazaquin), and Staple (pyrithiobac). The amino acid synthesis inhibitor herbicides are also contained in several premix packages (ex. Canopy, Finesse, Lightning). Peanut injury symptoms include chlorosis *(sometimes referred to as "yellow-flash")*, stunting, and the development of a blackened terminal. The yellow-flash symptom will usually disappear within 7-10 days after application.

*Yellow flash*

*Blackened growth terminal*

Additionally, the non-selective herbicides, Liberty (glufosinate), Roundup (glyphosate), and Touchdown (sulfosate) are also considered to be amino acid synthesis inhibitor herbicides. Plants treated with these herbicides first turn yellow then eventually turn brown and die. Liberty provides faster control than Roundup or Touchdown thus initial injury after application is in the form of a "burning" type of symptom. Since both Roundup and Touchdown

*Liberty*

are slower acting, a range of symptoms from green to yellow to brown may all be present on the same plant at the same time.

*Roundup damage*

## *Herbicide "Look-Alike" Symptoms*

Although herbicides can and do cause injury to peanut under certain conditions, they are not the only causes of peanut injury. Insect damage, diseases, excessive salt levels, mechanical tillage, soil fertility deficiencies/ toxicities, and other environmental factors can mimic herbicide symptoms. When problems occur, it is very easy to place the blame on herbicides in absence of other identifiable causes. Therefore, careful observation and analysis are critical to the identification of the actual causes of peanut injury symptoms.

*Fungicide injury*

*Iron chlorosis*

*Ozone injury*

*Genetic abnormality*

*Salt damage*

*Leafhopper burn*

## *Preventing Herbicide Injury*

Although it may be impossible to prevent all types of herbicide injury, the following suggestions can help to reduce the occurrence or severity:

1. Read and follow all label directions.

2. Sprayers should be calibrated at least once annually.

3. Adhere to the crop rotational restrictions of herbicides.

4. When applying herbicides to other crops and when peanut plants are in close proximity, be conscience of potential drift problems. Avoid herbicide applications in excessive wind (> 10 M.P.H.) and consider using low-drift nozzles and/or drift retardants.

5. Thoroughly clean the spray tank of herbicides that are not registered for use in peanut before using the tank for spraying peanut fields. Certain pesticide labels recommend the use of commercially prepared cleaning agents such as Incide-Out, Nutra-sol, Protank Cleaner, and Wipe-Out. Residues from growth regula-

tor herbicides (Banvel, Weedmaster, Grazon P+D, 2,4-D, etc.) require special cleaning agents such as household ammonia or a combination of washing soda, kerosene, and detergent. Most herbicide labels have specific recommendations for the proper removal of unwanted residues.

6. Avoid making postemergence applications of registered peanut herbicides when the plants are growing under stressful conditions (i.e., drought, excessive moisture, cold soil temperatures, etc.). The selectivity of many peanut herbicides is based upon the plant's ability to rapidly detoxify or metabolize the herbicide. These processes are reduced under stressful growing conditions.


## *Acknowledgments*

*The authors gratefully acknowledge the assistance of Jana Roberson in the preparation of this document. This document could not have been developed without the financial support of the Texas Peanut Producers' Board. Appreciation is extended to Dr. David L. Jordan - North Carolina State University and Dr. Scott A. Senseman - Texas A&M University for reviewing this publication.*





*Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture.*
*Chester P. Fehlis, Deputy Director, Texas Agricultural Extension Service, The Texas A&M University System.*

*May 1999*

# *Appendix I.*

Common name, trade names, and registered crops for herbicides discussed in this publication.

| Common Name | Trade Name(s) | Major Registered Crop(s) |
|---|---|---|
| 2,4-D | Several | corn, grain sorghum, pastures, rice, wheat |
| 2,4-DB | Butoxone, Butyrac, Several others | alfalfa, peanut, soybean |
| acifluorfen | Blazer | peanut, rice, soybean |
| atrazine | Aatrex, Atrazine, Several others | corn, grain sorghum |
| bentazon | Basagran | corn, grain sorghum, peanut, rice, soybean |
| bromoxynil | Buctril | alfalfa, corn, cotton, grain sorghum, wheat |
| chlorimuron | Classic | soybean, peanut |
| chlorsulfuron | Glean | wheat |
| clethodim | Select | alfalfa, cotton, peanut, soybean |
| clomazone | Command | cotton, soybean |
| clopyralid | Curtail, Reclaim, Stinger | corn, wheat, pasture |
| cyanazine | Bladex, CyPro | corn, cotton, grain sorghum |
| dicamba | Banvel, Clarity | corn, grain sorghum, wheat |
| dimethenamid | Frontier | corn, grain sorghum, peanut, soybean |
| diquat | Diquat | grain sorghum, soybean |
| diuron | Direx, Karmex | alfalfa, corn, cotton, grain sorghum, wheat |
| DSMA | Several | cotton |
| ethalfluralin | Sonalan | peanut, soybean |
| fluometuron | Cotoran, Meturon | cotton |
| fomesafen | Reflex | soybean |
| glufosinate | Liberty | corn (LL or GR hybrids), soybean |
| glyphosate | Roundup, Several others | corn, cotton, grain sorghum, pasture, peanut, rice, soybean, wheat |
| halosulfuron | Permit | corn, grain sorghum, turf |
| hexazinone | Velpar | alfalfa, pasture, range |
| imazapic | Cadre | peanut |

| Common Name | Trade Name(s) | Major Registered Crop(s) |
|---|---|---|
| imazaquin | Scepter | soybean |
| imazethapyr | Pursuit | alfalfa, corn (IMI hybrids), peanut, soybean |
| isoxaflutole | Balance | corn |
| lactofen | Cobra | cotton, soybean |
| metolachlor | Dual, Dual II, Dual II Magnum, Dual Magnum | corn, cotton, grain sorghym, peanut soybean |
| metribuzin | Lexone, Sencor | alfalfa, corn, soybean, wheat |
| metsulfuron | Ally | pasture, wheat |
| MSMA | Several | cotton, turf |
| nicosulfuron | Accent | corn |
| norflurazon | Zorial | alfalfa, cotton, peanut |
| oxyfluorfen | Goal | cotton |
| paraquat | Cyclone, Gramoxone Extra, Starfire | alfalfa, corn, cotton, grain sorghum, peanut, rice, soybean, wheat |
| pendimethalin | Prowl | corn, cotton, grain sorghum, peanut, rice, soybean |
| picloram | Tordon | pasture, wheat |
| primisulfuron | Beacon | corn |
| prometryn | Caparol, Cotton Pro | cotton |
| prosulfuron | Peak | grain sorghum, wheat |
| pyridate | Tough | corn, peanut |
| pyrithiobac | Staple | cotton |
| sethoxydim | Poast, Poast Plus | alfalfa, corn (SR or PP hybrids), cotton, peanut, soybean |
| sulfosate | Touchdown | corn, soybean |
| tebuthiuron | Spike | pasture |
| triasulfuron | Amber | pasture, wheat |
| triclopyr | Garlon, Grandstand R, Remedy | pasture, rice |
| trifluralin | Treflan, Trifluralin, Several others | alfalfa, corn, cotton, grain sorghum, peanut, soybean |