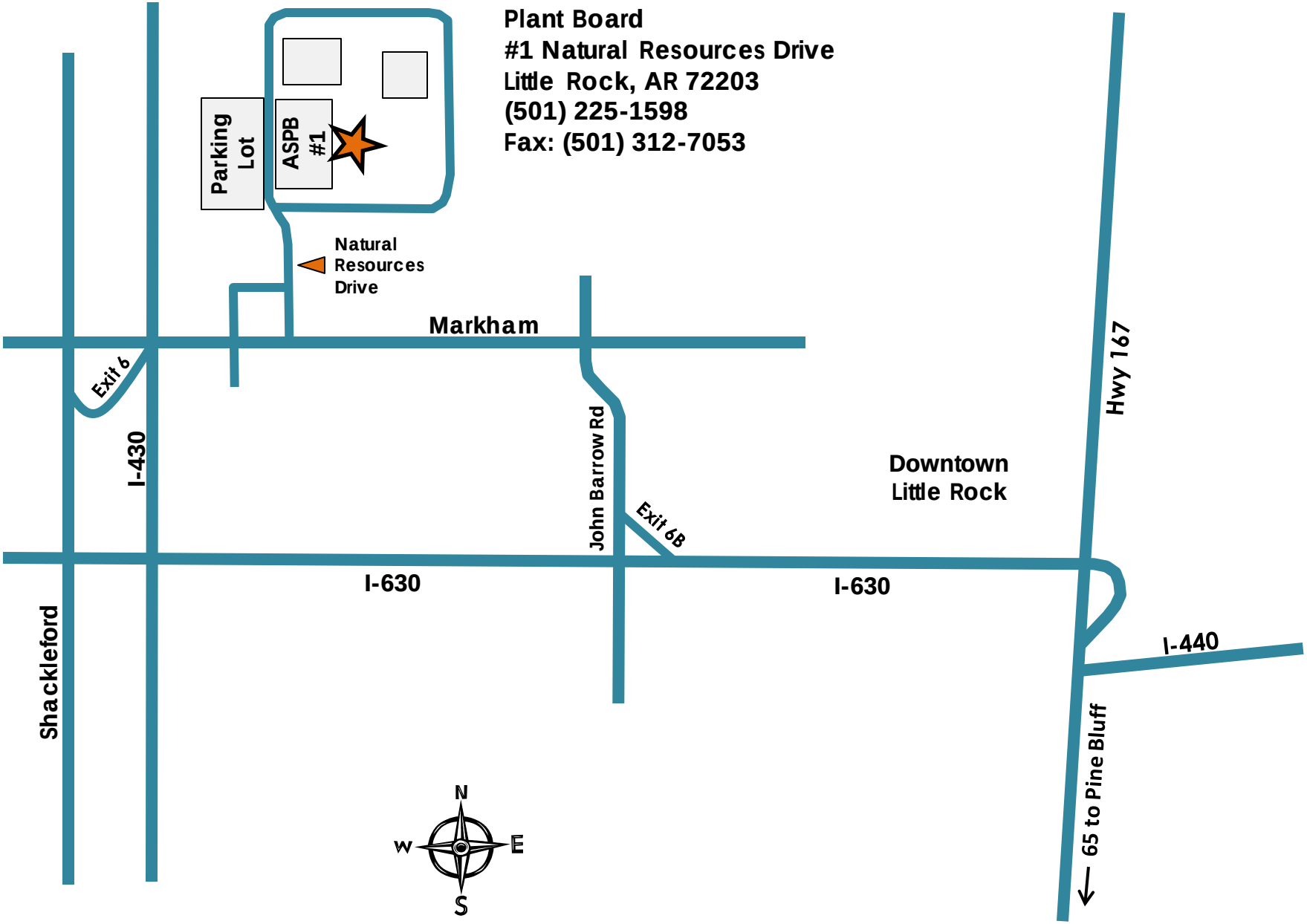
Plant Board
#1 Natural Resources Drive
Little Rock, AR 72203
(501) 225-1598
Fax: (501) 312-7053
Parking Lot
ASPB #1
Natural Resources Drive
Markham
Exit 6
I-430
John Barrow Rd
Exit 6B
Downtown Little Rock
Hwy 167
I-630
I-630
Shackleford
I-440
65 to Pine Bluff
N
W
E
S

Using Pesticides Safely

There are two good reasons for using pesticides safely:

- To keep yourself and other people from being poisoned
- To avoid harming the environment

How Pesticides Harm Man

Most pesticides can cause severe illness, or even death, if misused. But every registered pesticide can be used safely if you use it correctly.

Many accidental pesticide deaths are caused by eating or drinking the product. But some applicators die or are injured when they breathe a pesticide vapor or get a pesticide on their skin. Repeated exposure to small amounts of some pesticides can cause sudden severe illness.

To prevent *all* accidents with pesticides you should:

- Use and store pesticides away from children and other untrained persons
- Keep pesticides in their original containers
- Take care to follow directions when using them

Products for restricted use require special handling. The label is your guide.

Symptoms of Pesticide Poisoning

You should know the kinds of sickness that are caused by the pesticides you use.

Get medical advice quickly if you or any of your workers get sick during or after pesticide use. If you think a person may be poisoned, do not leave him alone. Do not let yourself or anyone else get dangerously sick before calling a physician or going to a hospital.

Take the container (or the label) of the pesticide with you. Do not carry a pesticide container in the passenger space of a car or truck. It is better to be too cautious than too late.

Parathion and Similar Pesticides (Organophosphates and Carbamates)

These pesticides injure the nervous system. The symptoms develop in stages. They usually occur in this order:

Mild Poisoning

- Fatigue
- Headache
- Dizziness
- Blurred vision
- Too much sweating and salivation
- Nausea and vomiting
- Stomach cramps or diarrhea

Moderate Poisoning

- Unable to walk
- Weakness
- Chest discomfort
- Muscle twitches
- Constriction of pupil of the eye
- Earlier symptoms become more severe

Severe Poisoning

- Unconsciousness
- Severe constriction of pupil of the eye
- Muscle twitches
- Secretions from mouth and nose
- Breathing difficulty
- Death if not treated

Illness may occur a few hours after exposure. But if symptoms start more than 12 hours after you were exposed to the pesticide, you probably have some other illness. Check with your physician to be sure. Several other pesticides may cause symptoms similar to these.

Fumigants and Solvents

Too much exposure to these chemicals may make a person appear drunk. The symptoms are:

- Poor coordination
- Slurring words
- Confusion
- Sleepiness

First Aid Procedures

Read the “Statement of Practical Treatment” on each label. The directions listed can save your life and the lives of your family and your workers.

If you get a pesticide on your skin:

- Remove the pesticide as quickly as possible. Remove all contaminated clothing. Prompt washing may prevent sickness even when the spill is very large. Detergents work better than soap in removing pesticides. Don’t forget your hair and fingernails.

Using Pesticides Safely

If you inhale a pesticide:

- Get to fresh air right away

If you splash a pesticide into your mouth or swallow it:

- Rinse your mouth with several glasses of water
- Go or be taken to a physician immediately
- It is sometimes dangerous to cause vomiting; follow label directions.

If a person has been poisoned, do not leave him alone.

In addition, remember to bathe using a detergent when you finish working with pesticides or pesticide-contaminated equipment. Any time you spill a pesticide on yourself, wash immediately.

Protecting Your Body

The label of each pesticide you use will tell you the kind of protection you need.

Protective Clothing

Body Covering – In general, any time you handle pesticides you should wear:

- A long-sleeved shirt and long-legged trousers, or
- A coverall type garment

Clothing should be made of closely woven fabric. When you handle pesticide concentrates or very toxic materials, also wear a liquid-proof raincoat or apron. Trousers should be *outside* of the boots to keep pesticides from getting inside.

Gloves – Gloves should be long enough to protect your wrist. They should be made of neoprene and not lined with a fabric. Never use cotton or leather gloves unless the

label tells you to. Sleeves should be *outside* of the gloves to keep pesticides from running down the sleeves and into the gloves.

Hat – Always wear something to protect your head. A wide-brimmed, waterproof hat will help protect your head, neck, eyes, mouth, and

face. Wide-brimmed plastic "hard hats" are good. They are waterproof and easy to clean and are cool in hot weather. A plastic sweatband is best.

Boots – Wear unlined neoprene boots. Do not use leather or canvas boots unless the label tells you to.

Goggles or Face Shield – Wear goggles or a face shield when

handling pesticides to avoid getting pesticides in your eyes.

Care of Clothing – Wear clean clothing daily. If clothes get wet with spray, change them right away. If they get wet with pesticide concentrates or highly toxic pesticides, destroy them. They are hard to get clean in normal home laundering. Never store or wash pesticide contaminated clothing with the family laundry. Wash hats, gloves, and boots daily. Test gloves for leaks by filling them with water and gently squeezing.

Wash goggles or face shields at least once a day. Elastic fabric headbands absorb pesticides. Use neoprene headbands.

Respiratory Protective Devices

You *must* wear an approved respiratory device when the label directs you to do so. Follow the label instructions on respiratory protection.

Chemical Cartridge Respirators

These half-face masks cover the mouth and nose.

ailing edge of the wing reduces the amount of ›ray trapped in the vortex circulation. Recent ASA research on fixed wing aircraft indicates ıat removing nozzles inboard from the wing ps until a 10 percent reduction in effective vath width was noted will reduce (by up to) percent) potential driftable fines. Fly-in attern testing has verified that the drift hazard eduction is maximized by not placing a nozzle ithin 6 to 10 feet of the wing tip. Normally, the vath width of conventional aircraft is not educed by reducing the boom length to 70 or 75 ercent of the wingspan. The effect of reducing oom length more than 70 percent depends on ıe aircraft, nozzle pressure, and spray droplet ze.

Applicator tests using rotary nozzles (i.e., Micronair) have indicated that the outermost ozzle position may be positioned inboard as uch as 55 percent of the wingspan to ensure ıat material is not entrained in the wing tip ortex circulation.

Nozzle stoppage, improper swath width, and ther factors can cause poor distribution. Strips f poor weed control, streaking, indicate poor istribution. However, identifying the cause and emedying this problem from field results is trictly chance. If one waits for problems to how up in a field situation, the damage has lready been done and is hard to remedy. Pat- ern testing should be completed and calibration djustments made to the aircraft to obtain niform deposition prior to making annual pplications. Some useful patterning techniques re described later in this publication.

Basic Formulas for Aircraft Calibration

Calibration is a process to determine how uch liquid solution must be delivered from the ozzles to deposit the required amount of roduct active ingredient (AI) per acre. The mount of material applied by an aircraft can be hanged only by a change in ground speed or a hange in flow rate. Swath width should never e used as a method of changing the application rate without physically changing the nozzle configuration. The basic steps of aircraft calibration are:

Case 1

1. Determine the acres your aircraft system treats per minute at the speed and estimated swath width you plan to fly. The effective swath width should match that determined by pattern testing.

   Equation 1
   Acres per Minute = (.00202)(Swath Width)(Speed)

   Example using: 60 ft swath and 120 MPH
   Acres/Minute = (.00202)(60 ft)(120 MPH) = 14.4

2. Determine the gallons you must spray per minute to apply the recommended gallonage rate.

   Equation 2
   GPM = (Acres per Minute)(Application Rate)

   Example using: 10 gallons per acre
   GPM = (14.4 A/min)(10 GPA) = 144 GPM

3. Once the flow rate has been determined, select the nozzle orifice size and number of nozzles needed to deliver the correct number of gallons per minute within the allowable operating pressure range of your system. It is generally recommended that spray pressures remain greater than 18 psi and less than 40 psi (preferably 18-30 psi to minimize drift).

Case 2

Determine the number of nozzles to use. Assume your are using a nozzle with a flow rate of 3 GPM at 25 psi.

Equation 3

$$\text{Number of Nozzles} = \frac{\text{Total Flow}}{\text{GPM per Nozzle}}$$

$$\frac{144 \text{ GPM}}{3 \text{ GPM/Nozzle}} = 48 \text{ Nozzles Needed}$$

A total of 48 nozzles would need to be operational to obtain the desired application rate. The positioning of each nozzle should be selected and the system pattern tested to verify distribution pattern uniformity and nozzle pattern changes required.

se 3

Determine what nozzle tip size to use. For s calculation, the total number of nozzle let positions on the boom or the total number positions one plans to use must be selected ore calculations begin. Assume that 66 zles are needed.

Equation 4

$$\text{GPM per Nozzle} = \frac{\text{Total Flow}}{\text{Number of Nozzles}}$$

$$\frac{144 \text{ GPM}}{66 \text{ Nozzles}} = 2.18 \text{ GPM}$$

Based on this calculation, one would select a zle that has a flow rate close to 2.18 GPM in desired pressure range of 18-30 psi.

Calculating flow rates from individual zles once they are mounted on a boom sys- is difficult, especially when equipping an raft for high application rates. Individual zle flow rates vary depending on location, ulence in the boom, and the number of m restrictions. After placing nozzles on the m, make a trial run to ensure the proper lication rate is being applied and that the ay results in a uniform deposition. A high nber of larger nozzles (larger orifices) results igh fluid velocities inside the boom and a ge pressure drop from the center of the boom he end of the boom where the last nozzle is ated. This pressure differential may result in rower effective swath widths. Full three inch uid systems (no restrictions smaller than ee inches from the pump outlet on) are ommended for field applications greater than PA.

The exact flow rate (GPM) or pressure (psi) ded for a particular nozzle may not be listed the available tables. If the flow rate is known one pressure, the pressure or flow rate can be culated for other pressures or flow rates by ng the following equation:

Equation 5

$$\frac{GPM_1}{GPM_2} = \frac{\sqrt{PSI_1}}{\sqrt{PSI_2}}$$

If the desired pressure is known, the unknown nozzle flow rate may be calculated by rearranging the above equation:

Equation 6

$$GPM_{Unknown} = \frac{(GPM_{Known})(\sqrt{PSI_{Desired}})}{\sqrt{PSI_{Known}}}$$

Or if a desired flow rate is known, the needed pressure may be calculated by rearranging Equation 6:

Equation 7

$$PSI_{Unknown} = \left(\frac{(GPM_{Desired})(\sqrt{PSI_{Known}})}{GPM_{Known}} \right)^2$$

This relationship is accurate for most hydraulic nozzles.

As an example, suppose we would like to use 6530 flat fan tips at a flow rate for Case 3 scenario above. From the nozzle catalog, determine that the flow rate of this nozzle at 40 psi is 3.0 GPM.

$$PSI_{Unknown} = \left(\frac{(2.18 \text{ GPM})(\sqrt{40 \text{ PSI}})}{3.0 \text{ GPM}} \right)^2 = 21 \text{ PSI}$$

From Equation 7 the unknown pressure needed to provide a flow rate of 2.18 GPM with this nozzle is calculated to be 21 psi. This is within the acceptable range for this nozzle.

The above calculation assumes that all nozzles receive the same pressure. This is usually not the case, especially on higher volume applications. Pressures will usually have to be increased approximately 10 percent to compensate for flow restrictions and pressure loss along the boom.

Inboard and outboard pressure gauges should be installed to check for significant (1-2 psig or more) pressure drops along the boom at high flow rates. Switch gauge positions to check for gauge error. Make a trial run to ensure the aircraft is dispersing the desired application rate.

ARKANSAS DEPARTMENT OF AGRICULTURE
Plant Industries Division, Pesticide Section
1 Natural Resources Dr
Little Rock, AR 72205

Forms of 2,4-D and Other Phenoxy Type Herbicides

Phenoxy type herbicides are usually present as acids, salts, and as low-volatile and high-volatile esters. All are permissible for general use except high-volatile esters. Below are listed some of the various forms:

PERMISSIBLE FORMS

Low Volatile Esters	Salts
Butoxyethanol ester Butoxyethoxypropyl ester Butoxypropyl ester 2-ethyl, 4-methyl pentanol ester	Banvel [Dimethylamine salt of dicamba (3,6-dichloro-o-anisic acid)] Dimethylamine D-isopropanolamine Lithium N-oleyl 1,3 propylene diamine Tordon (Potassium salt of 4-amino-3, 5, 6-trichloropicolinic acid) Tertiary dodecyl amine Triethylamine Trimethylamine
Acides	
2,4-dichlorophenoxyacetic acid Butoxone or Butyrac 4 (2,4-dichlorophenoxy) butyric acid 2-methyl-4-chlorphenoxyacetic acid	

PROHIBITED FORMS

High Volatile Esters	
Butyl	Methyl
Ethyl	Pentyl, or amyl
Isopropyl	Propyl

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2013 version

RECOMMENDED CHEMICALS FOR WEED AND BRUSH CONTROL

Prepared By
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The control of weeds and brush is essential for the economical production of crops. The high cost and decreasing availability of labor make it necessary to fit the use of herbicides into the production practices already in use on many crops.

This publication is a summary of the latest recommendations for the use of herbicides in Arkansas and conforms with federal and state regulations. Supplemental leaflets giving more detailed information on herbicide usage for specific crops are listed in this book. For some crops, new herbicides or practices are suggested for trial usage on limited acreages and are not listed in this publication. Further information on these materials can be obtained from the county Extension agent. A herbicide should be tried on a limited acreage until one is experienced with it. Because of volatility and drift hazards to sensitive crops, 2,4-D related compounds must be applied according to Arkansas State Plant Board and regulations listed in Revised Circular No. 9A, *Arkansas Regulations on 2,4-D, 2,4-DB, MCPA and Other State Restricted Use Herbicides*, which are available from P.O. Box 1069, Little Rock, Arkansas 72203, or from the county Extension agent. It is important that the user of a herbicide **carefully read and follow the label directions and precautions** on the container. See label on grazing restrictions.

NOTE:

Herbicide rates recommended are all on a broadcast basis unless specified. When a herbicide is applied as a band over the row, reduce the rate of material accordingly.

$$\text{i.e. } \frac{\text{Band width}}{\text{Row width}} \times \text{Broadcast rate} = \text{Band rate}$$

For example, where the material is applied in 19" bands on 38" rows, the rate of material should be decreased to 19/38 or 1/2 of the amount suggested for broadcast spray. Refer to herbicide application section for specific examples.

Conversion Table

1 tablespoon = 3 teaspoons (0.5 oz)
1 oz = 2 tablespoons
1 cup (1/2 pint) = 16 tablespoons (8 oz)
1 pint (2 cups) = 32 tablespoons (16 oz or 1 lb) (473 ml)
1 gallon (16 cups) = 8 pints or 4 quarts (8.4 lb water)
1 cu ft = 7.48 gal (62.4 lb)
1 acre = 43,560 sq ft
1 ppm = 3.6 oz/A inch = 0.0038 grams/gal
1 cfs = 450 gal/min
1 mph = 88 ft/min

$$\text{Acres} = \frac{\text{Length (ft) x width (ft)}}{43{,}560}$$

$$\text{Number of Rows/A} = \frac{43{,}560}{\text{Row width (ft) x row length (ft)}}$$

Trial or Limited Use

Certain new herbicides are suggested to be used on a limited acreage. An individual producer will determine the extent of his usage of these materials. This type of suggestion is included for those materials which have shown promise but have not yet received broad scale field evaluation. Those recommended for trial use are shaded as this is.

Rating Tables

The rating tables preceding the recommendations for each crop give the performance the University of Arkansas Research and Extension personnel expect under optimum conditions, which include such factors as proper incorporation, adequate moisture for activation, proper timing, spray coverage for postemergence herbicides, etc.

Since many factors may cause a herbicide to vary in performance, the University of Arkansas in no way guarantees these estimates. In addition, a high rating on a weed that is not listed on a herbicide label does not constitute a recommendation for that particular herbicide on that particular weed. Rating scale is 0-10, where 10 equals excellent control and 0 equals no control. A "–" indicates no data.

Herbicide Spray Additives

The addition of a surfactant to a postemergence herbicide spray mixture in many cases increases its effectiveness. Where a surfactant is called for, use the herbicide manufacturer's label recommendations.

HERBICIDE APPLICATION

Tips for Proper Mixing*

1. See that **equipment is clean and in good running condition,** free of oil, grease or residue.
2. Always **follow label instructions** about mixtures.
3. If there's any question about compatibility, **do a jar test first.**
4. Add chemicals in W-A-L-E sequence.

   Wettable powders or water dispersible granules
   Agitation
   Liquids (flowable liquids)
   Emulsifiable concentrates
5. Start with **tank** 1/4 **full** of carrier, and add **all** W or WDG chemicals first.
6. Get good, strong agitation with a rolling effect on the surface of the carrier. Allow time for good dispersal.
7. Have a shut-off valve installed in the bottom of each tank.
8. Use a 16-mesh suction screen to allow chemicals to circulate through the pump.
9. Empty the tank as much as possible before mixing a new batch.

Compatibility Test: Since liquid fertilizers can vary, even within the same analysis, always **check compatibility with herbicide(s) each time before use.** Be especially careful when using complete suspension or fluid fertilizers as serious compatibility problems are more likely to occur. Commercial application equipment may improve compatibility in some instances. The following test assumes a spray volume of 25 gallons per acre. For other spray volumes, make appropriate changes in the ingredients. Check compatibility using this procedure:

1. Add 1 pint of fertilizer to each of 2 one-quart jars with tight lids.
2. To **one** of the jars add 1/4 teaspoon or 1.2 milliliters of a compatibility agent approved for this use, such as Compex or Unite (1/4 teaspoon is equivalent to 2 pints per 100 gallons of spray). Shake or stir gently to mix.
3. To **both** jars add the appropriate amount of herbicide(s). If more than one herbicide is used, add them separately with dry herbicides first, flowables next and emulsifiable concentrates last. After each addition, shake or stir gently to thoroughly mix. The appropriate amount of herbicides for this test follows:

   Dry herbicides: For each pound to be applied per acre, add 1.5 level teaspoons to each jar.

   Liquid herbicides: For each pint to be applied per acre, add 0.5 teaspoon or 2.5 milliliters to each jar.
4. After adding all ingredients, put lids on and tighten, and invert each jar ten times to mix. Let the mixtures stand 15 minutes and then look for separation, large flakes, precipitates, gels, heavy oily film on the jar or other signs of incompatibility. Determine if the compatibility agent is needed in the spray mixture by comparing the two jars. If either mixture separates but can be remixed readily, the mixture can be sprayed as long as good agitation is used. If the mixtures are incompatible, test the following methods of improving compatibility: (A) slurry the dry herbicide(s) in water before addition, or (B) add 1/2 of the compatibility agent to the fertilizer and the other 1/2 to the emulsifiable concentrate or flowable herbicide before addition to the mixture.

Checklist for Proper Spray Application

If you cannot check all the following (where applicable), perhaps you have a weakness in your weed control program that can be corrected.

( ) 1. Use flat fan or other nozzle designed for uniform distribution when making broadcast applications.
( ) 2. Use "E" (even-spray) nozzles for banding behind press wheel.
( ) 3. Use flat fan or OC nozzles for postdirected.
( ) 4. Use a minimum screen size of 50 mesh for wettable powders or flowables.
( ) 5. Use stainless steel, ceramic or nylon tips for wettable powders or flowables.
( ) 6. Accurately measure band width.
( ) 7. Convert broadcast rates for band.
( ) 8. Accurately calibrate sprayer.
( ) 9. Refer to label and precautions in this publication to choose proper spray volume and pressure for herbicide used.
( ) 10. Have proper equipment for the herbicide.
( ) 11. Have proper agitation (not just bypass) for powders and flowables.

Herbicide Application

The success of any herbicide treatment depends upon proper application. The following information should provide some guidelines for proper application. This material lacks detail in several areas such as nozzle selection, agitation, etc. However, detailed information on most aspects of spray application is available from your county Extension agent.

Spray Volumes

In general, spray volumes should be in the 5 to 20 gpa range (ground application) for broadcast, soil-applied herbicides. For band applications, a volume equivalent to 1/2 gallon per inch of band is sufficient (i.e., 10 gpa on a 20-inch band). These volumes are usually adequate for postemergence herbicides, but there are exceptions. Refer to the comments on each herbicide to note any specific application instructions.

Sprayer Tank Agitation

The type of pesticide formulation dictates the need for agitation. Soluble liquids, soluble powders and emulsifiable concentrates require little agitation. Usually the flow from the bypass hose maintains a uniform mixture.

Wettable powder and flowable formulations are only in suspension, and they require vigorous agitation to prevent settling out. Every year, many instances can be cited where insufficient agitation has resulted in excessive crop injury, loss of crop and/or lack of weed control.

Jet Agitation in a Nutshell

1. Insufficient agitation can cost more than the entire sprayer cost.
2. Running a bypass hose into the tank is not agitation.
3. Agitation can be expected to use more pump capacity than the nozzles require.
4. Pre-mixing wettable powders will get pesticides into suspension; insufficient agitation allows them to drop out. Continue agitation until all the spray is distributed.

Nozzle Tips

Herbicides are best applied with the proper nozzle tip design. For broadcast application of soil- or foliar-applied herbicides, use a flat fan tip such as an 8003, LF3-80°, etc. The tip size will depend on the pressure and speed. For postemergence directed herbicides, use a **flat fan** tip such as 8002 and LF2-80° or an **off center** tip such as an OC-02. For band application behind the planter, use an **even spray** tip such as 8003-E or LE3-80°. Note the band application behind the planter is the only use for the even spray tips.

For wettable powder application, use stainless steel, ceramic, or nylon tips and a 50-mesh screen. For more information on nozzle selection and special applications, refer to manufacturers' catalogs.

Nozzle Selection

Manufacturers of spray nozzles provide a wealth of information about the selection, setup and use of their products in their catalogs. These include such things as hose flow information and nozzle selection guides. It would be impractical to reprint all that information here. Manuals or catalogs for the type of product you are using are obtained from dealers. If you cannot locate a personal copy, each county Extension office usually keeps at least one copy of popular brand item catalogs.

Nozzle manufacturers continue to offer more types of tips to improve spray applications. Most nozzle tips are now color coded to improve size distinction. Nozzle caps are now designed for easy on/off to facilitate cleaning when necessary. Most nozzle tips have a code stamped on them somewhere. These codes describe the nozzle characteristics, size and material type. Examples – 8002VK is an eighty degree flat fan, size number 2, ceramic tip, and a LFR80-3 Thermoplastic is an eighty degree extended range flat fan tip in size 3 made of thermoplastic material. Tips are available in a number of materials. Stainless steel, nylon and ceramics offer the best wear characteristics. Most manufacturers offer an extended range type flat fan nozzle which helps eliminate some drift potential if operated at lower pressures. Low operation pressures also extend tip life.

Many nozzle manufacturers now utilize air induction chambers to help control the droplet spectrum. This helps avoid the development of so many fine spray particles. Nozzle chambers also help stabilize the droplet spectrum over a wider pressure range.

A good tool of any spray operation is a current manufacturer's catalog. Obtain one for the type spray components you are using and read it carefully to improve your spray accuracy. Several nozzle manufacturer addresses and web pages are listed here. Most have excellent web pages with a wealth of information. Web pages and catalogs should be studied carefully for nozzle selection, setup and operation.

Spray Equipment Addresses:

Teejet Midwest
3062 104th Street
Urbandale, IA 50322
Phone: 515-270-8415
http://www.teejet.com

Greenleaf Technologies
P. O. Box 1767
Covington, LA 70434
Phone: 800-881-4832
sales@turbodrop.com
www.greenleaftech.com

Lurmark Nozzles
Hypro Corporation
375 Fifth Avenue NW
New Brighton, MN 55112-3288
http://www.hypropumps.com/en-us/Products

Wilger, Inc.
Mark H. Bartel
16540 Hwy 104 North
Lexington, TN 38351-6358
Phone: 877-968-7695
wilgeresc@netease.net
www.wilger.net

Wind Compensation

When wind velocity is too high to be practical, the best solution is to park the sprayer. However, there are approaches to compensate for some wind. One solution is to change tips. Use a larger tip (i.e., an 8005 instead of an 8003), and lower the spray pressure (i.e., go up on the nozzle size and down on the pressure). Also, consider a wider angle tip such as a 9503 instead of an 8003. This allows the nozzle to be adjusted closer to the ground without changing the width of the spray pattern where it impacts on the ground. Properly used low pressure tips and Raindrop nozzles will reduce the drift possibility. Low pressure nozzles will substitute for flat fans. Raindrop nozzles (RA series) should be angled either 45° forward or back. Follow the manufacturer's recommendations. The new air induction style nozzles emit fewer fines and may be a very good tool to avoid drift potential. Air induction tips are typically not as sensitive to droplet size changes as operating pressures increase. This helps avoid small droplet formations when the sprayer is operating at higher speeds and the flow control is increasing pressure to ensure the correct dosage.

Band Application

All rates are given as broadcast rates. For band application, you **must** adjust the rate by the following formula:

$$\frac{\text{Band width}}{\text{Row width}} \times \text{Broadcast Rate} = \text{Band Rate}$$

Refer to calibration examples on following pages.

Sprayer Calibration

Useful Formulas

$$\text{GPM (Per Nozzle)} = \frac{\text{GPA} \times \text{mph} \times \text{W}}{5{,}940}$$

$$\text{GPA} = \frac{5{,}940 \times \text{GPM (Per Nozzle)}}{\text{mph} \times \text{W}}$$

GPM – gallons per minute
GPA – gallons per acre
mph – miles per hour
W – nozzle spacing (in inches) for broadcast spraying
– spray width (in inches) for single nozzle, band spraying or boomless spraying
– row spacing (in inches) divided by the number of nozzles per row for directed spraying

Measuring Travel Speed

Measure a test course in the area to be sprayed or in an area with similar surface conditions. Minimum lengths of 100 and 200 feet are recommended for measuring speeds up to 5 and 10 mph, respectively. Determine the time required to travel the test course. To help ensure accuracy, conduct the speed check with a loaded sprayer and select the engine throttle setting and gear that will be used when spraying. Repeat the above process and average the times that were measured. Use the following equation or the table on page 6 to determine ground speed.

$$\text{Speed (mph)} = \frac{\text{Distance (ft)} \times 60}{\text{Time (seconds)} \times 88}$$

Miscellaneous Conversion Factors

One acre = 43,560 square feet = 0.405 hectares

One hectare = 2.471 acres

One gallon per acre = 9.35 liters per hectare

One mile = 5,280 feet = 1,610 meters = 1.61 kilometers

One gallon = 128 fluid ounces = 8 pints = 4 quarts
= 3.79 liters = 0.83 imperial gallons

One pound per square inch = 0.069 bar
= 6,896 kilopascal

One mile per hour = 1.609 kilometers per hour

No single aspect of spray application is as important and so abused as sprayer calibration. There is no way to accurately apply a herbicide without accurately calibrating the sprayer and figuring the tank mix. Using the following method and examples, you can calibrate quickly, so do it!

Determining Gallons Per Acre (ounce method)

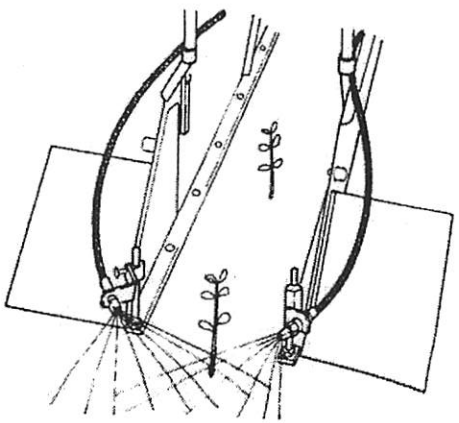
1. Check the table below for the proper distance related to the row or nozzle spacing on your sprayer. For broadcast, use nozzle spacing; for band application such as post directed or band behind press wheel, use row spacing. Mark off this distance in the field you will be spraying.

Row or Nozzle Spacing (Inches)	Calibration Distance (Feet)
40	102
38	107
36	113
34	120
32	127
30	136
28	146
26	157
24	170
22	185
20	204
18	227

For row or nozzle spacings and calibration distances not shown here, any calibration distance (feet) may be determined by the following equation: 4080 / (average row or nozzle spacing) in inches.

2. Attach row conditioner, Triple-K, planter or whatever tool to be pulled by the tractor when spraying. Engage the tool to the proper depth and use the throttle setting and gear that will be used for spraying. Note on a stopwatch the time in seconds that it takes to drive the calibration distance measured.

3. Catch the nozzle discharge for the noted time in Step 2 in a container graduated in ounces (plastic measuring cup, baby bottle, etc.). If you are using a broadcast boom with nozzles spaced evenly, catch the output from one nozzle for the time measured in Step 2.



If more than one nozzle per row is used (directed, insecticide or fungicide rig), catch the spray from each nozzle for the time noted in Step 2. Then combine the amount from all nozzles spraying on a single row.

4. The total discharge measured in ounces is equal to the gallons per acre applied. With a broadcast boom, this is the amount caught from one nozzle. Where you have used row spacing in Step 1, all nozzles directed to that row must be measured to determine the gallons per acre.

5. Check each nozzle to assure equal spray distribution across the width of the sprayer. Repeat Steps 3 and 4 to assure that nozzles do not vary more than 10 percent across the width of the sprayer.

Determining Tank Mix

Divide tank refill capacity by the calibrated gallons per acre (determined in Step 4). This is the number of acres the sprayer will cover per refill. Multiply the broadcast rate of herbicide (or band rate) times the acreage per refill to get the amount of herbicide (commercial product) to be put in the tank.

Example 1 – Broadcast Application

A grower will apply Anychem 1 with a broadcast boom having nozzles spaced 20 inches apart while pulling a disk for incorporation.

Step 1 The distance to travel for 20-inch **nozzle** spacing is 204 feet. Measure 204 feet in the field to be sprayed.

Step 2 Select the desired gear and throttle setting with the disk down. Let's say it takes 20 seconds to cover the 204 feet.

Step 3 Set the pressure to be used and catch one nozzle's output for 20 seconds (the time required to travel the 204 feet).

Step 4 The output in ounces is the amount applied in gallons per acre. If the nozzle output was 15 ounces in 20 seconds, the sprayer applies 15 gpa.

Step 5 Repeat Step 4, checking each nozzle.

Let's assume you have a 200-gallon tank and wish to apply one pint of Anychem 1 per acre.

$$\frac{\text{200 gal/refill}}{\text{15 gpa}} = \text{13.3 acres covered per tank (or refill)}$$

Since you wish to use 1 pt/A, you would use 13.3 pints of Anychem 1 per refill, i.e., 1 pt/A x 13.3 acres = 13.3 pints.

[See Note in Example 2]

Example 2 – Band Behind Planter

A grower will apply Anychem 2 behind his planter with a 14-inch spray band on a 38-inch row.

Step 1 The distance to travel for a 38-inch row is 107 feet.

Step 2 Select the planting speed and travel the measured 107 feet with planter down. Let's say it takes 18 seconds in this example.

Step 3 Set the pressure and catch one nozzle's output for 18 seconds (the time required to travel 107 feet).

Step 4 The output in ounces is the amount applied in gallons per acre. If the nozzle output was 10 ounces in 18 seconds, the sprayer applies 10 gpa. (This is all on a band.)

Step 5 Repeat Step 4, checking each nozzle.

Let's assume a 400-gallon tank (two 200-gallon saddle tanks) refill capacity and the rate of Anychem 2 50W for your soil is 1 lb/A **broadcast**. Reduce this rate to a 14-inch band.

$$\frac{14\text{" band}}{38\text{" row}} \times 1 \text{ lb/A} = .37 \text{ lb/A to be applied on the band}$$

$$\frac{400 \text{ gal/refill}}{10 \text{ gpa}} = 40 \text{ acres per tank refill}$$

40 acres x 0.37 lb/A = 14.8 lbs of Anychem 2 50W per tank refill; i.e., 7.4 lbs in each 200-gallon saddle tank.

NOTE: Plan on the amount of water required to refill the tank, **not** the capacity of the tank itself. For example, if you have the above 200-gallon saddle tanks but you have 50 gallons of spray left in each when you refill, it only takes 300 gallons to refill them.

Therefore:

$$\frac{300 \text{ gal/refill}}{10 \text{ gpa}} = 30 \text{ acres per refill}$$

30 A/refill x 0.37 lb/A = 11 lbs of Anychem 2 50W per refill (5.5 lbs in each of the two tanks).

Example 3 – Directed Spray

A grower will apply Anychem 3 + Anychem 4 on a 16-inch band on a 32-inch row using 2 OC-02 nozzles per row (one on each side).

Step 1 The distance to travel for a 32-inch row is 127 feet.

Step 2 Select speed and drive the 127 feet. Assume it takes 15 seconds.

Step 3 Set the pressure and catch each of the 2 nozzles per row for 15 seconds or time determined in Step 2.

Step 4 Add the quantity from the two tips. The amount in ounces is the gallons per acre. Assume 5 ounces per tip for a total of 10; therefore, a 10 gpa output.

Step 5 Repeat Step 4, checking the nozzles on each row.

Let's assume two 200-gallon saddle tanks and the **broadcast** rate is 1 lb Anychem 3 50W + 1 pt Anychem 4 per acre. Reduce the rates for the 16-in band:

16/32 x 1 lb = 1/2 lb Anychem 3 16/32 x 1 pt = 1/2 pt Anychem 4/A

$$\frac{400 \text{ gal tank capacity}}{10 \text{ gpa}} = 40 \text{ acres per refill}$$

40 acres x 1/2 lb Anychem 3 = 20 lb Anychem 3
40 acres x 1/2 pt Anychem 4 = 20 pts Anychem 4
Put 1/2 this amount (10 lb Anychem 3 + 10 pt Anychem 4) in **each** tank.

Postemergence Spray Application

Following are some guidelines and diagrams for properly applying postemergence directed herbicides and for ground application of contact/systemic materials.

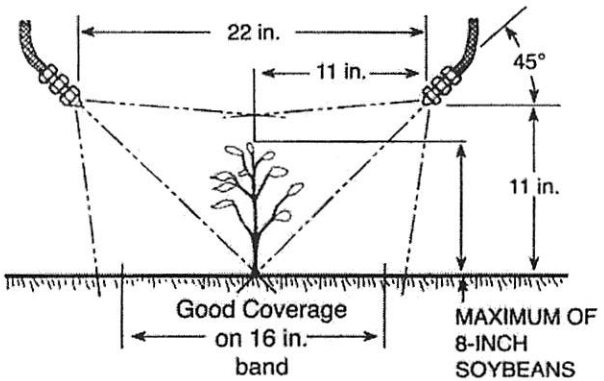
Nozzle Arrangements for Row Banding Overtop Herbicides

Guidelines

Adjust sprayer to apply a minimum of 20 gal/A broadcast at 20-60 psi.
Two-nozzle arrangements effective on 6 inch tall or smaller weeds.
Keep nozzles a minimum of 10 inches from soybean canopy to develop pattern width.
Nozzles should never be angled less than 45° to horizontal because part of the spray will be aimed upward.
Spray should overlap cultivated ground at least 4 inches to assure weed-free row shoulders.
Coverage is essential (contact herbicide).

Soybeans Up to 8 Inches Tall

TWO NOZZLE ARRANGEMENT



Nozzles can be angled greater than 45° or moved to spacings narrower than 22 inches where soybeans and weeds are small.

Special 95° tips can be used where nozzle support doesn't permit adequate nozzle spacing. Angle these tips downward at least 50° from horizontal and keep them a minimum of 8 inches from soybean canopy.

Always measure the band width to determine proper herbicide tank mix.

Nozzle Tip Options
(two nozzles on 38-inch row)*

Speed (mph)	Flat Fan (50 psi)
4	LF2-80°, 8002 (17 gpa)
6	LF2-80°, 8002 (12 gpa)
8	LF3-80°, 8003 (13 gpa)

*EXAMPLE ONLY – lower pressures may be selected and corresponding rate determined.

SUPPLEMENTAL PUBLICATIONS

* MP169, *Weeds of Arkansas Lawns, Turf, Roadsides and Recreation Areas*
MP192, *Rice Production Handbook*
* MP193, *Identifying Seedling and Immature Weeds of Arkansas Field Crops*
MP197, *Arkansas Soybean Handbook*
MP370, *Turfgrass Weed Control for Professionals*
FSA2080, *Pasture Weed and Brush Control*
FSA2109, *Home Lawn Weed Control*
FSA3054, *Musk Thistle*
FSA6123, *Weed Control in Container Nurseries*
FSA6124, *Woody Plant Control in Home Landscapes*
FSA6127, *Weed Control in Field Nurseries*
FSA6137, *Weed Control in Landscape Plantings*

(Check for current revisions of the above publications.)

FOR FURTHER INFORMATION ON HERBICIDES,
SEE YOUR COUNTY EXTENSION AGENT.

A suggested equipment cleanup procedure to follow immediately after applying phenoxy formulations is:

(1) Flush system completely with detergent water; drain.

(2) Flush system with ammonia solution (1 quart ammonia per 25 gallons water); drain.

(3) Fill system completely with above concentration ammonia solution; let stand overnight.

(4) Drain system next day; flush with excess water.

(5) Flush system the day before next use.

(6) Clean outside of equipment and nozzle assemblies in above manner.

This method is not foolproof but should reduce the hazards involved in applying phenoxy amine herbicides.

Some chemicals used for weed control can be injurious to man if handled carelessly. They can also be injurious to desirable plants, livestock, wildlife and fish if improperly applied. Care should be exercised in the use of herbicides and the disposal of unused herbicides to avoid polluting streams and water supplies. Precautions for handling and applying that are printed on the container label should be followed.

*For sale only.

Cooperative Effort Addresses Drift Concerns

The 1996 growing season was highlighted by the launch of plant biotechnology products in the U.S., including insect resistant cotton and corn and herbicide resistant cotton and soybeans. The Arkansas Plant Board believes that Roundup Ready Soybean and Cotton technologies will be key components to this rapidly growing trend. Because of these new technologies, greatly increased use of Roundup Ultra herbicide is anticipated. These new technologies will enable American farmers to feed a growing world population.

Last year, the Plant Board began hearing concerns of off-target spray drift from the use of some commonly used herbicides, including Roundup Ultra. This issue was raised during the period between mid-April to mid-May, when windy conditions in Arkansas were greater than in past years. Some applicators felt that off-target movement was greater with Monsanto's new formulation, Roundup Ultra, than the previous Roundup D-Pak formulation.

The Plant Board investigated the situation with ground and aerial applicators, University of Arkansas Extension Specialists and Monsanto technical personnel. Extensive field and laboratory studies were conducted in several states to analyze product formulations, nozzle and droplet sizes, wind speed, spray drift additives and many other application factors.

In addition, an in-depth study recently conducted by Texas A&M University concluded that there was no significant difference in spray drift potential between Roundup Ultra, Roundup D-Pak, or other Roundup formulations.

Monsanto and the Plant Board have conducted several working meetings to develop Best Management Practices (BMPs) to reduce the potential for drift with Roundup Ultra. Monsanto has agreed to submit a supplemental state label for aerial applications of Roundup products for Arkansas, which includes BMPs that address maximum wind speeds, minimum boom height above the crop, droplet sizes, and buffer zones. Monsanto will also conduct an applicator education and certification program.

The Plant Board, University of Arkansas Extension Service, and Monsanto will continue to monitor the use of Roundup Ultra, as well as other pesticides in 1997 for off-target movement and will fine-tune recommendations on an as needed basis

"We appreciate the cooperative relationship that has been developed between Monsanto Company and the Plant Board to take a proactive approach in addressing this issue", said Don Alexander, Arkansas Plant Board Director.

ARKANSAS DEPARTMENT OF AGRICULTURE
Plant Industries Division, Pesticide Section
1 Natural Resources Dr
Little Rock, AR 72205

Volatility and Drift of 2,4-D, 4-DB, MCPA And Other Hormone-Type Herbicides

When discussing volatility, many times it is apparent that it is confused with drift. Let us examine these briefly. Volatility is "the tendency of a liquid to pass into a vapor state at ordinary temperatures". Air temperature is commonly considered as "ordinary" temperature and is usually much higher than the solution or emulsion being sprayed. The diluent or water in each droplet may evaporate; however, the herbicide does not, thus the most significant change is a decrease in droplet size. Volatility is involved only when the herbicide vaporizes, either at the time of spraying or after the spray droplet is deposited on the target plant.

Drift can be defined as "to float or be driven along by a wind current". This is quite different from volatility in that the herbicide is physically moved "as is". The drift potential is much greater for the smaller droplets, as applied, or which result from the evaporation of the water or diluent phase of the droplet, or those which occur as undesirable "fines" as may be caused by high pressures, improper nozzles, etc. Air inversion can also be a contributing factor. Under ordinary conditions, drift of spray droplets does not again occur after once being deposited.

Pesticide Applicators & Pesticide Dealers

Information You Should Know

Worker Protection Standard

You must:

- Follow all Worker Protection Standard (WPS) Label Directions
- Provide pesticide safety training for your workers and handlers
- Have an Environmental Protection Agency (EPA) Safety Poster at your central location
- Supply your employees with Personal Protective Equipment (PPE) in clean operating condition
- Provide emergency assistance when handlers or workers have been poisoned or injured by pesticides
- Post written warnings or orally warn workers who will be within a 1/4 mile of a treated area
- Establish a decontamination site within 1/4 mile of all workers and handlers
- Provide enough water for routine and emergency whole body wash and for eye flushing

All of the information can be found in "The Worker Protection Standard For Agricultural Pesticides - How To Comply" Manual.

Resources

WPS resources can be found on Pesticide Educational Resource Collaborative (PERC) website at **www.pesticideresources.org**, or contact the Pesticide Section at the Arkansas Department of Agriculture, Plant Industries Division at (501) 225-1598.

Restricted Use Pesticide Dealer

- A license is required to purchase any Federal or State Restricted Use Pesticide (RUP) in Arkansas.
- Federal RUPs will be clearly marked on the outside container label.
- State RUPs include products designated as Class F (2,4-D) and/or Class H (dicamba) in containers more than one quart for Agricultural Use.
- Please reference the "Arkansas Regulations on Pesticide Classification" on the Arkansas Department of Agriculture Plant Industries Division webpage for the most current information on Pesticide Classification.
- All license expire December 31 of each year.

The "Registered Pesticide Search" feature allows public access to the Pesticide Registration database. Labels and product specific information can be viewed for all products registered in Arkansas. Also available on the webpage is a list of Federally Restricted Use Pesticides and State Restricted Use Pesticides.

Visit the Pesticide Registration webpage for more information at:
agriculture.arkansas.gov/plant-industries/pesticide-section/registration

Commercial/Non-Commercial

- It is a violation of the law for a dealer to sell Restricted Use Pesticides (RUP) to an individual that does not have a current year license. Duly licensed applicators should be prepared to show their license when making a purchase.

- Commercial/Non-Commercial applicators, do not wait until the last minute to apply for an applicator's license. If you wait until you need the license to pursue it, the processing time may hold you up.

- All commercial applications made by ground must be done under the supervision of a certified, licensed Commercial Applicator. The driver/operator of the vehicle must be either a certified, licensed Commercial Applicator or a licensed Commercial Applicator Technician (CAT).

- Equipment set up must meet droplet size specifications for herbicide application to field crops. Please refer to the regulations regarding droplet size formation to prevent off target movement of pesticides.

- Refer to Regulations Under Act 389 of 1975 as amended, for additional information.

Private Applicators

*Must be a producer of a Agricultural Commodity

Initial Certification

Certification for a first time applicant can be obtained in one of two ways:

1. Applicant may attend the Pesticide Applicator Training offered by one of the County Cooperative Extension Offices each year.

2. Applicant must pass an exam administered by the Arkansas Department of Agriculture. The certification or recertification will be valid for either one 5-year license or five 1-year licenses.

Recertification

There are two methods of recertification:

1. Applicant may attend the Pesticide Applicator Training offered by one of the County Cooperative Extension Offices each year, or

2. NEW! Applicant may complete the Online Recertification Training available through the University of Arkansas Cooperative Extension Service.

Extension Service Website:

www.uaex.edu/farm-ranch/pest-management/pesticide-licensing/

Renewal applications will be mailed 30 days before your old license expires. Once certified or recertified, complete application form (DP-25) and submit with fee to:

Arkansas Department of Agriculture
Plant Industries Division, Pesticide Section
1 Natural Resources Drive
Little Rock, AR 72205

Pesticide Applicators & Pesticide Dealers

IMPORTANT NOTICE!
Please Read The Label
Before You Mix The Chemicals

It is the responsibility of commercial applicators to be aware of all label requirements and crop restrictions for each pesticide applied to a clients field crop. Commercial and non-commercial pesticide applicators, pesticide dealer representatives, crop consultants, and chemical manufacturer representatives who misuse or recommend the misuse of a pesticide will be held responsible for the label violation.

Current Pesticide Laws and Regulations can be found at: **agriculture.arkansas.gov/plant-industries/pestcide-secton/laws**

Questions?

We're here to help!

For further information about Pesticide Applicators & Pesticide Dealers, see resources available online at **agriculture.arkansas.gov/plant-industries/pesticide-section**

Arkansas Department of Agriculture
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(501) 225-1598 | agriculture.arkansas.gov

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