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COMMONWEALTH OF KENTUCKY
TRANSPORTATION CABINET
Frankfort, Kentucky 40622
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Greg Thomas
Secretary

OFFICE OF THE SECRETARY
OFFICIAL ORDER 110352

SUBJECT: *Pesticide Guidance Manual*

This manual has been prepared to provide information and guidance to personnel of the Kentucky Transportation Cabinet. Its purpose is to establish uniformity in the interpretation and administration of laws, regulations, policies, and procedures applicable to pesticide usage in maintenance operations of the Department of Highways.

The policies and procedures set forth herein are hereby approved and declared effective unless officially changed.

All previous instructions, written and oral, relative to or in conflict with this manual are hereby superseded.

Signed and approved this 28th day of July, 2016.

Greg Thomas
Secretary

Approved as to Legal Form

Office of Legal Services

PESTICIDE

GUIDANCE MANUAL

ISSUED BY

COMMONWEALTH OF KENTUCKY
TRANSPORTATION CABINET

JULY 2016

Produced by Organizational Management Branch
Office of Human Resource Management

PREFACE

The Division of Maintenance's *Pesticide Guidance Manual* is written as a guide to maintenance personnel in the Kentucky Transportation Cabinet's Department of Highways. This manual mentions several specific products used by maintenance personnel to complete daily tasks and are included solely for this purpose.

This manual assumes no liability on the part of the Kentucky Transportation Cabinet for the products included nor is it intended to promote any product, supplier, or manufacturer over another. Furthermore, inclusion in this manual does not imply continued or future use of a product.

DIVISION OF MAINTENANCE

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ORGANIZATION & NUMBERING

Chapter Title—The subject matter in the manual is divided into chapters. The chapter title appears in the upper right-hand corner of the first page of a subject and in the upper left-hand corner of any subsequent page.

Subject Title—The title of a subject appears in the upper right-hand corner of the first page of a subject and in the upper left-hand corner of any subsequent page.

"PEST" Prefix—Preceding each subject number, this prefix stands for the manual title *Pesticide Manual.*

Date—The latest issuance date of a subject appears at the bottom of each page of the subject. This date agrees with the latest issuance date shown for the subject in the Table of Contents (**PEST-01**).

Page Numbering—Each subject has its own page numbering, which appears at the bottom of each page.

LOCATING INFORMATION

One index appears at the front of the manual, and one index appears at the back:

Table of Contents—This index at the front lists the titles of the manual's chapters and their subjects, as well as other information, in numerical order. It includes the latest issuance dates of all the subjects. As the manual matures, these dates change.

Table of Exhibits—This index at the back lists the exhibits referenced in the manual.

CROSS REFERENCES IN MANUAL

Subject Numbers within Narrative—A subject number within the narrative on a page directs the user to more information about the subject.

QUESTIONS

Whom to Contact—For answers to questions about the contents of the manual, please contact:

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DIVISION OF MAINTENANCE	*Chapter*
	INTRODUCTION
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PURPOSE

The Department of Highways shall conduct a Vegetation Management Program on the roadside rights of way of all highways that are the responsibility of the department. This program shall complement the maintenance program through the safe and economical control of undesirable vegetation on roadsides.

To assist in meeting the goals of the Vegetation Management Program, this manual details the department's policies and procedures for maintenance personnel in the administration, use, and application of pesticides.

OVERVIEW

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the original law regulating pesticides, was passed by Congress in 1947 and amended in 1972, 1975, and 1978. FIFRA regulates the registration, manufacture, transportation, and use of pesticides. Since 2012, pesticide applications have also been regulated under the Clean Water Act by the National Pollution Discharge Elimination System. In Kentucky, the Kentucky Fertilizer and Pesticide Storage, and Pesticide Use and Application Act (KRS 217B) and the Kentucky Pollution Discharge Elimination System General Permit for Pesticide Application KYG99 regulate pesticides at the state level.

At the federal level, the U.S. Environmental Protection Agency (EPA) is responsible for carrying out the rules and regulations provided by FIFRA and the Clean Water Act.

At the state level, the Division of Environmental Services, Kentucky Department of Agriculture is responsible for carrying out the provisions of KRS 217B. The Department of Highways is responsible for controlling various noxious weeds as stated in KRS 176.051, KRS 249.183, KRS 249.187, KRS 249.190, and KRS 249.195. The Kentucky Division of Water enforces the KYG99 General Permit.

KRS 176.051 Department to eradicate noxious weeds on rights-of-way—Advertisement of program – Administrative regulations.

(1) The Department of Highways shall keep all state rights-of-way free of all of the following, which are noxious weeds and invasive plants:

(a) The species of grass, Sorghum halapense, commonly known as Johnson grass
(b) The species of weed commonly known as giant foxtail
(c) The thistles Cirsium arvense and Carduus nutans, commonly known as Canada thistle and nodding thistle; respectively
(d) Multiflora rose
(e) Kudzu
(f) Poison hemlock
(g) Marestail
(h) Amur honeysuckle
(i) Japanese knotweed
(j) Common teasel

(2) Upon written request, the department shall give priority to and shall cooperate with any abutting property owner engaged in a program of eradication by eradicating the noxious weeds and invasive plants, identified in subsection (1) of this section, or in administrative regulations promulgated pursuant to subsection (4) of this section, from abutting state rights-of-way. The department shall take steps to eradicate this grass and these weeds or thistles by use of chemicals or any other means found to be effective by the department.

(3) The Department of Highways shall inform property owners of the availability of the eradication program. In carrying out this responsibility, the department shall no later than the first week in March of every year, advertise in each county, pursuant to the provisions of KRS Chapter 424 that the program is available. The department shall stipulate in the advertisement the place and manner in which an interested property owner may make a written request for inclusion in the program. The department shall also promote awareness of the availability of the eradication program through the use of electronic media and the Cooperative Extension Service.

(4) (a) The Department of Highways may by administrative regulation add noxious weeds and invasive plants to or delete them from the list of noxious weeds and invasive plants enumerated in subsection (1) of this section. In making a determination regarding a noxious weed or invasive plant, the department may consider the following:

KRS 176.051 (CONT.)

1. The plant's ability to directly or indirectly injure our cause damage to crops, livestock, poultry, or other interests of agriculture
2. The plant's impact on the public health
3. The plant's impact on the environment
4. The level of difficulty associated with controlling or eradicating the plant

(b) The department shall review this administrative regulation at least once every four years.

Effective: July 15, 2014

KRS 249.183 Canada and nodding thistle eradication areas, establishment, duties of agriculture department.

(1) The fiscal court of any county may, after notice and hearing, declare that a threat exists to the natural resource development and the agricultural economy of the county by reason of the growth and infestation of Canada thistles (cirsium arvense) or nodding thistles (carduus nutans) or both. The notice shall be given by publication pursuant to KRS Chapter 424. If after the hearing the fiscal court finds that thistles are a threat in its county it shall by resolution so declare and make a request to the State Department of Agriculture for assistance to eradicate thistles.

A copy of the resolution shall be promptly certified and forwarded by the clerk of the court to the Commissioner of Agriculture.

(2) (a) Upon receipt of the resolution adopted pursuant to subsection (1) of this section the Commissioner of Agriculture shall promptly undertake the eradication of thistles in the county for which the resolution was adopted.

(b) The Commissioner shall appoint a county thistle control board consisting of three (3) citizens of the county to serve as advisers and to assist in the administration of this law and to perform such other duties as prescribed by the Commissioner. Members of the county thistle control board shall receive no salary but shall be reimbursed by the fiscal court for necessary expenses incurred in performance of their duties.

KRS 249.183 (CONT.)

(c) The Commissioner of Agriculture, in any county declared a thistle eradication area under subsection (1) of this section may enter upon any lands for the purpose of inspecting same and to insure compliance with KRS 249.183 to 249.195 and 249.991. He may enter into cooperative agreements with state and federal agencies and departments for the furtherance of the control and eradication of thistles. He shall make all rules and regulations necessary to carry out the provisions of KRS 249.183 to 249.195 and 249.991.

(d) The Commissioner may give the notice prescribed by KRS 249.190 to any landowner and if the landowner fails to comply with that section, he shall enter upon the land and cut, spray or take such other measures, as he deems proper to eradicate the thistles. Notice to a landowner who does not reside in the county or who is unknown shall be given by posting of the notice on the land and at the front door of the courthouse in the county. The Commissioner may recover from the landowner the compensation fixed by KRS 249.190, for such eradication work. Any action for the recovery of such compensation shall be brought in the county in which the land is located and shall be governed by the Rules of Civil Procedure.

(3) The fiscal court of any county declared a thistle eradication area under subsection (1) of this section may by resolution declare that the threat to natural resources and agricultural economy in the county has ceased to exist and upon the adoption of the resolution, a copy thereof shall be delivered to the Commissioner of Agriculture. Upon receipt of a copy of the resolution, all work on eradication of thistles in the county under the direction of the Commissioner shall be discontinued.

(4) In the administration of KRS 249.183 to 249.195 and 249.991 the Commissioner may employ such persons and delegate to them such powers as are necessary to carry out the purposes of KRS 249.183 to 249.195 and 249.991.

(5) Neither the Commissioner of Agriculture nor any agent or other person acting under his direction shall be liable for any damages or injury to property or crops resulting from the administration or enforcement of KRS 249.183 to 249.195 and 249.991 unless the damage is caused by failure to exercise ordinary care to avoid or prevent the damage or injury.

History: Created 1968 Ky. Acts ch. 11, secs. 1, 2, 3, 5, and 6.

KRS 249.187 Thistles a public nuisance in eradication area, abatement.

The existence or growth of Canada or nodding thistles in any county declared to be a thistle eradication area is declared to be a public nuisance and the Commissioner of Agriculture may bring an appropriate action in such county to enjoin such nuisance. At the request of the Commissioner, the county attorney shall prosecute such action.

History: Created 1968 Ky. Acts ch. 11, sec. 4.

KRS 249.190 Entry and cutting of thistles on failure of landholder -- Exemption.

(1) If any person who holds land on which Canada or nodding thistles are growing and likely to ripen seed, neglects or refuses to cut and destroy them, the Commissioner of Agriculture pursuant to subsection (2) of KRS 249.183, shall give fifteen (15) days' notice in writing to the person who holds the land, to cut and destroy the Canada or nodding thistles. On the neglect or refusal of the person who holds the land to cut and destroy them at the end of fifteen (15) days, the Commissioner of Agriculture may enter upon or hire other persons to enter upon the land and cut down and destroy the Canada or nodding thistles. The Commissioner of Agriculture may recover from the person who holds the land the reasonable costs of the eradication.

(2) Land on which conventional farm machinery cannot be safely operated shall be exempt from this section.

Effective: April 10, 1990

KRS 249.195 Thistle eradication on highway and utility rights-of-way.

All public utilities, the State Highway Department, the county judge/executive, railroads, drainage districts, school districts, road districts, game preserves, and other public and quasi-public corporations and every landowner in thistle eradication areas shall:

(1) Take action to control and eradicate Canada and nodding thistles and prevent their regrowth and reinfestation on all lands, rights-of-way and easements owned, occupied, or controlled by them;

(2) Employ methods of control and eradication and for the prevention of the regrowth and reinfestation of thistles by April 15 of each year in those counties in the Central Time Zone and by April 25 of each year in those counties in the Eastern Time Zone as directed by the Commissioner of Agriculture or the county thistle control board; and

KRS 249.195 (CONT.)

(3) Comply with all orders, rules and regulations promulgated by the Commissioner of Agriculture pursuant to KRS 249.183 to 249.195 and 249.991.

Effective: April 10, 1990

DIVISION OF MAINTENANCE	*Chapter* INTRODUCTION
	*Subject* Definitions & Labeling

DEFINITIONS

The Environmental Protection Agency provides that:

- **Pesticide**—Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest

  Note: Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

- **Toxicity**—The capacity of a chemical to do harm to an organism by other than mechanical means

- **Acute Toxicity**—The poisoning that occurs after a single exposure to a toxic substance (effects shortly after exposure)

- **Chronic Toxicity**—The effects of long-term or repeated low-level exposures to a toxic substance (cancer, liver damage, reproductive disorders, etc.)

- **Lethal Dose 50 (LD 50)**—The dose of a toxicant that will kill 50 percent of test organisms within a designated period

  Note: The lower the LD 50 is, the more toxic the compound.

PESTICIDE TOXICITY

Exhibit PEST-9023, "Toxicity Ratings & Classification" provides information on specific pesticide toxicities and categories.

GENERAL OR RESTRICTED USE

Each use of every pesticide product will be classified by the EPA as either general or restricted. A general-use pesticide can be purchased and used by any responsible adult. A restricted-use pesticide can be legally purchased or used only by or under the direct supervision of a certified pesticide applicator that has had special training in matters relating to pesticides. Currently, all pesticides used by the Kentucky Department of Highways are general-use.

Exhibit PEST-9005, "Current Trade Names & Product Manufacturer Addresses", lists pesticides approved for KYTC projects.

LABELING

The applicator **shall not**:

- Use any pesticide in a manner not permitted by the labeling
- Use higher amounts, higher concentrations, or more frequent applications than those stated on the label

Note: The applicator may mix two or more pesticides if all the amounts are at or below the recommended rate.

Each pesticide used has a label attached that provides instructions on proper usage. The label is a legal document subject to federal and state pesticide laws. To the applicator, the label is a source of facts on how to use the product correctly and legally. To physicians and other medical personnel, the label is a source of information on proper treatment for persons affected by the pesticide.

The label includes the following:

- Brand name of the product
- Chemical names of the active ingredients and the percentage of inert (non-active) ingredients present in the product
- Net contents or size of package
- Registration and establishment numbers that identify the product and its manufacturer
- Statements relating to environmental concerns, toxicity and any special precautions that should be taken when mixing, applying, storing, or disposing of the product
- Use classification (general or restricted)
- Directions for uses
- Signal words and symbols found on labels

LABELING (CONT.)

Maintenance personnel shall contact the National Pesticide Information Center (NPIC) if a label for a pesticide cannot be located. **Exhibit PEST-9017**, "Pesticide Emergency Contacts", provides all emergency contact numbers.

Exhibit PEST-9010, "Understanding Pesticide Labels & Labeling", provides more information on pesticide labels and labeling.

SIGNAL WORDS

The label contains a signal word to alert the user of how dangerous the product is to humans. The signal word must appear in large letters on the front panel of the label. The signal words found on labels are:

- **DANGER**—This signal word tells you that the pesticide is highly toxic. Any product that is highly toxic by mouth, skin, or lungs will be labeled **DANGER** and carry the word **POISON** printed in red along with the skull and crossbones symbol. These pesticides should have an antidote listed on the label.

- **WARNING**—This word signals that the product is moderately toxic. Any product that is moderately toxic by mouth, skin, or lungs or causes moderate eye or skin irritation will be labeled **WARNING**.

- **CAUTION**—This word signals that the product is slightly toxic. Any product that is slightly toxic by mouth, skin, or lungs will be labeled **CAUTION**.

  Note: By its oral toxicity to rats, aspirin would be labeled **CAUTION** if it were a registered pesticide.

- **KEEP OUT OF REACH OF CHILDREN**—Every pesticide label carries this statement by law and it must be interpreted to also mean, "keep out of reach of adults who are deficient mentally, either retarded from birth or senile because of illness or age."

DIVISION OF MAINTENANCE	*Chapter*
	VEGETATION MANAGEMENT
	Subject
	Planning

RESPONSIBILITIES

The Roadside Manager and Central Office Division of Maintenance staff have the responsibility for establishing guidelines and procedures for the storage, use, and handling of pesticide materials. They also test and screen new pesticide products, select the pesticide materials that are to be used in the Vegetation Management Program, and make recommendations as to how these materials will be used.

The roadside environment district administrator (REDA) in each district shall be responsible for the proper use, storage, and handling of pesticides within the district. To have an effective program, the REDA shall:

- Make a survey of the vegetation of all areas
- Determine approximate time for work activities to be performed
- Determine the types and amounts of materials needed
- Determine equipment needs
- Determine the type and number of personnel required

Exhibit PEST-9024 provides a list of roadside environment district administrators.

The REDAs and all department employees involved in the handling, storage, and application of pesticide materials shall be certified as noncommercial applicators in Category 6. In addition, a limited number of applicators per district should be certified in Category 3 and Category 5 to handle any landscape or aquatic applications required. This certification is administered through testing by the Kentucky Department of Agriculture, Division of Environmental Services. **PEST-211**, "Training," provides additional information on this testing.

SELECTION OF PESTICIDES

The Division of Maintenance shall select and recommend approved pesticides for each type of application as noted in the Kentucky Department of Highways' Pesticide Program Chart (**Exhibit PEST-9019**). The Division of Maintenance will provide the districts with an updated copy of the Pesticide Program Chart as needed.

Maintenance employees shall retrieve the Label and Material Safety Data Sheet (MSDS) of each approved pesticide product from the Roadside Environment Branch website:

http://transportation.ky.gov/Maintenance/pesticide.asp

INVENTORY

The Operations Management System (OMS) maintains a monthly inventory of pesticide materials in stock. The district OMS coordinator can provide information relating to purchasing pesticide materials.

GAINING ACCESS TO PRIVATE PROPERTY

As detailed in the *Maintenance Guidance Manual* (**MAIN-210**), a TC 71-14 form, *Consent and Release* (**Exhibit PEST-9004**), shall be properly executed by the department and the property owners when it becomes necessary for maintenance personnel to work on property that is not controlled or owned by the department.

APPLICATION OF PESTICIDES

Pesticide applications shall comply with federal label regulations and shall not be made until the applicator has read the label.

Before applying pesticides, the district shall adequately plan each application to assure effective control considering the stages of vegetative growth and types of vegetation present. The district shall use the Pesticide Program Chart (**Exhibit PEST-9019**) to select pesticides to be used and to determine the method, rate, and timing of applications.

The applicator shall perform surveillance of the route noting any sensitive sites such as stream crossings, susceptible crops or landscaping, and habitat for threatened and endangered species.

APPLICATION OF PESTICIDES (CONT.)

Maintenance personnel shall not apply pesticides when wind velocity would move the product off target. **PEST-410**, "Drift Management," provides more information.

Bare ground product applications shall not deviate from the Pesticide Program Chart as to rates and application. Maintenance personnel shall keep the use of hand applicators to a minimum. When using hand applicators, maintenance personnel shall take care when applying to areas such as pavements, sealed shoulders, sealed traffic islands, and signposts to prevent the product from moving off target through other applications. **PEST-403**, "Applying Pesticides," provides more information.

INSECTICIDE APPLICATION

The Division of Maintenance shall pre-approve all insecticides applied on highway rights of way including rest areas.

The method and rate of application of the insecticide shall conform to the pesticide label.

Before applying an insecticide, the applicator shall refer to **PEST-303**, "Pesticide Contact and Exposure," concerning pesticide overexposure.

When applying an insecticide, the Materials Safety Data Sheet shall be available to and in the presence of the applicator.

The applicator shall wear protective clothing as prescribed by the EPA when applying an insecticide. **PEST-302**, "Personal Protective Equipment," provides more information.

DIVISION OF MAINTENANCE	*Chapter*
	VEGETATION MANAGEMENT
	Subject
	Reporting

POLICY

All pesticides shall be used at the rates recommended and in accordance with the Department of Highway's Pesticide Program Chart (**Exhibit PEST-9019**). The Division of Maintenance Central Office shall provide this chart to each Roadside Environment District Administrator (REDA).

All pesticide use shall be documented on a TC 71-108 form, *Pesticide Field Report* (**Exhibit PEST-9018**), and the crew superintendent shall sign, date, and submit the TC 71-108 to the Division of Maintenance where it will be filed.

DIVISION OF MAINTENANCE	*Chapter*
	VEGETATION MANAGEMENT
	Subject Coordinating Pesticide Applications with Mowing Operations

SCHEDULES

Each district shall coordinate pesticide spraying operations with mowing activities when both are to be performed on the same area during the year. Before undertaking mowing operations, maintenance personnel shall allow sufficient time following pesticide applications for the pesticide to be effective. If the proper amount of time cannot be allowed following an application, maintenance personnel shall mow the area first and apply the pesticide product to the vegetative regrowth when adequate growth is present.

The *Maintenance Guidance Manual* (**MAIN-705**) provides more information on mowing policies and procedures.

DIVISION OF MAINTENANCE	*Chapter*
	VEGETATION MANAGEMENT
	Subject Seeding, Protection, & Fertilization Operations

SEEDING, PROTECTION & FERTILIZATION OPERATIONS

The department shall perform proper seeding and protection techniques on roadside areas where grass or other vegetative ground cover is lacking and the potential for soil erosion is imminent. The department may also perform proper maintenance practices to provide adequate fertility for established grass turf and other vegetative ground cover.

These seeding and protection techniques and the application of fertilizers to roadsides shall comply with the Department of Highways' *Seeding and Fertilization Program Chart* (**Exhibit PEST-9026**).

DIVISION OF MAINTENANCE	*Chapter* VEGETATION MANAGEMENT
	*Subject* Growth Regulator Pesticides

APPLICATION

Maintenance personnel shall apply plant growth regulators:

- In selected areas for height control of grasses and to prevent the emergence of a seed head on those grasses
- In the spring when the grasses are in an active stage of growth prior to the time of seed head emergence
- On well established grasses and not to newly seeded grass areas
- Only one time to any area during any one growing season

Areas to be considered when applying plant growth regulators are:

- Vegetative areas 10—15 feet behind guardrails where mowing is difficult or unsafe
- Vegetative shoulder areas between pavement and guardrails
- Narrow vegetated raised medians
- Slopes where grass height needs to be controlled and the areas are difficult or unsafe to mow
- Areas heavily landscaped where mowing is difficult
- Interchange ramps, islands, and other areas where mowing is difficult or unsafe and grass height must be controlled
- Under guardrails where the use of bare ground products is not available

DIVISION OF MAINTENANCE	*Chapter* VEGETATION MANAGEMENT
	*Subject* Weed & Brush Control

WEED & BRUSH CONTROL

The department shall perform proper maintenance techniques to control weeds and brush on highway rights of way.

The use of pesticides to accomplish this task shall comply with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); with the Clean Water Act (CWA); with the Kentucky Department of Agriculture Pesticide Use and Application Act (KRS 217B); and as dictated by the Kentucky Department of Highways' Pesticide Chart (**Exhibit PEST-9019**).

When using pesticides to control roadside brush, maintenance personnel shall take care to allow for a minimum of discoloration. Excessive discoloration of brush should be avoided.

Pesticides can control woody vegetation that is 30 inches or less in height or can be used to chemically side-trim encroaching branches in accordance with procedures outlined in the Pesticide Program Chart under the Broadleaf Weed Control Section. The control of brush with the application of selective pesticides shall be limited to those areas where brush encroachment on roadsides creates a safety sight distance problem or impedes roadside drainage. Maintenance personnel can make these applications between August 1 and the time of normal leaf drop in the fall. Dormant applications should be made between December 1 and March 1.

Caution will be taken in the selection and application of pesticides for a minimum discoloration of brush. Excessive discoloration of brush shall be avoided.

In areas where brush is removed from roadsides by mechanical or hand cutting methods, maintenance personnel shall treat stumps with the pesticide product recommended by the Pesticide Program Chart to prevent resprouting.

RESTRICTIONS OF PESTICIDE USE

Maintenance personnel shall not apply pesticides (used for control of weeds and brush on roadsides) to the following:

- Fence rows not on state right of way
- National forest areas, unless by permit from the National Forest Service
- Areas adjacent to susceptible crops
- Areas of standing or moving water

DIVISION OF MAINTENANCE	*Chapter* VEGETATION MANAGEMENT
	*Subject* Noxious Weed Control

POLICY

The department shall perform proper techniques to control the following noxious weeds on all highway rights of way in accordance with KRS 176.051:

- Nodding (Musk) Thistle (**PEST-501**)
- Canada Thistle (**PEST-502**)
- Johnson Grass (**PEST-503**)
- Giant Foxtail (**PEST-504**)
- Marestail (**PEST-505**)
- Common Teasel (**PEST-506**)
- Poison Hemlock (**PEST-507**)
- Kudzu(**PEST-508**)
- Multiflora Rose (**PEST-509**)
- Amur Honeysuckle (**PEST-510**)
- Japanese Knotweed (**PEST – 511**)

Upon written request (via the TC 71-226 form, *Noxious Weed Control Request* [**Exhibit PEST-9014**]) from abutting property owners engaged in the eradication of these noxious weeds, the department will cooperate with such abutting property owners by controlling such noxious weeds on abutting state rights of way.

In accordance with KRS 176.051, the department shall **no later than the first week in March of each year** advertise in each county, pursuant to the provisions of KRS Chapter 424, that the noxious weed control program is available. The department shall stipulate in these advertisements the place and manner in which an interested property owner may make a written request for inclusion in the noxious weed control program.

Upon notice that a county fiscal court declares their specific county a thistle eradication area, the department, in accordance with KRS 249.183, shall comply with the Department of Agriculture by eradicating the thistle from the highway rights of way in that county.

DIVISION OF MAINTENANCE	*Chapter* VEGETATION MANAGEMENT
	*Subject* Landscape Plant Maintenance

POLICY

The Department of Highways shall maintain landscape plantings on all roads that are the responsibility of the department.

Any landscape plantings placed on the right of way through a permit shall be the responsibility of the permittee.

A landscape maintenance program shall include the following:

- Designation of areas where work will be performed and approximate time work will be done
- Determination of type work to be performed
- Selection of pesticides, if needed
- Determination of equipment needs and availability

Landscape plants shall be periodically fertilized. The Division of Maintenance may recommend the proper rates of fertilizer and approximate times of application. All pesticides used by the department shall be approved by the Division of Maintenance before use in the districts. The Division of Maintenance will provide the districts with proper recommendations on specific pesticides before actual application. The following pesticides may be used:

- **Insecticides**—In areas where insects are damaging plants, insecticides shall be applied for control.
- **Fungicides**—In areas where fungus diseases are damaging landscape plants, fungicides shall be applied for proper control.
- **Herbicides**—Where applicable, herbicides may be used around plants and in shrub beds to control weed growth. Personnel shall carefully observe proper chemical application rates so as to not injure landscape plants.

DIVISION OF MAINTENANCE	*Chapter* VEGETATION MANAGEMENT
	*Subject* Stumps & Stump Treatments

POLICY

The chief district engineer through the transportation engineer branch manager (TEBM) for the Project Delivery and Preservation Branch and the roadside environment district administrator, as their delegates, shall develop a plan for the removal of trees and brush that:

- Present potential hazards along the roadway
- Impede drainage
- Encroach onto the roadway
- Create a problem of safety and sight distance

STUMPS & STUMP TREATMENTS

Stumps that remain after the removal of trees shall be a maximum of three inches (3") above the ground. Where maintenance personnel removes brush from roadsides by mechanical or hand-cutting methods, the stumps will be treated with the pesticide product recommended by the Pesticide Program Chart (**Exhibit PEST-9019**) to prevent resprouting.

DIVISION OF MAINTENANCE	*Chapter*
	VEGETATION MANAGEMENT
	Subject
	Sprayer Equipment

POLICY

The Division of Maintenance shall:

- Review equipment requests
- Recommend the type to be purchased

  Note: Exhibits PEST-9001, PEST-9013, & PEST-9016 provide examples of the types of sprayer equipment available.
- Recommend alterations to equipment in accordance with desired results and district requests

MAIN-1700, "Equipment," of the *Maintenance Guidance Manual* provides information concerning all equipment.

SPRAYER OPERATION

Exhibit PEST-9021 provides information concerning sprayer nozzles selection and calibration.

Exhibit PEST-9002 provides examples on calibration methods.

DIVISION OF MAINTENANCE	*Chapter* VEGETATION MANAGEMENT
	*Subject* Training

OVERVIEW

Prior to the spring growing season, the Department of Highways provides annual training opportunities to personnel using and handling pesticides.

All maintenance employees involved in the use, application, handling, and storage of pesticides shall be certified in compliance with the Kentucky Department of Agriculture Pesticide Use and Application Act (KRS 217B).

The roadside environment district administrator from each district and the Central Office roadside environment team may attend statewide roadside vegetation meetings approved by the Kentucky Department of Agriculture, Division of Environmental Services to update their pesticide application licenses and certifications.

The department may elect, either through the Division of Maintenance or through the districts, to conduct training on the proper operation, performance, and preventative maintenance of mowing equipment.

Supervisors must contact the Professional Development Branch in the Office of Human Resource Management to schedule training courses and seminars.

For more information on pesticide certification requirements, visit the University of Kentucky, College of Agriculture's Pesticide Safety Education Program website at:

http://pest.ca.uky.edu/PSEP/welcome.html

DIVISION OF MAINTENANCE	*Chapter*
	SAFETY
	Subject
	Overview

GOAL

The Kentucky Department of Highways has the responsibility to ensure the safe, economical, and effective use of pesticides to control and eliminate grasses, weeds, and brush that create safety hazards and that are detrimental to the aesthetics of highway roadsides.

PERSONNEL RESPONSIBILITIES

The department encourages and enforces a pesticide management program that minimizes the risk of adverse human and environmental health effects by requiring personnel to:

- Comply with state and federal laws pertaining to pesticide application
- Receive proper training, licensing, and certification

  Note: **PEST-211** details training procedures.
- Read and follow instructions on pesticide product labeling and Material Safety Data Sheets (MSDS)

  Note: **PEST-103** provides more information on product labeling.
- Demonstrate proper pesticide management practices relating to handling, transporting, storage, and disposal techniques

  Note: **PEST-400** details pesticide use and controls.
- Follow recommendations of personal protective equipment (PPE)

  Note: **PEST-302** provides PPE requirements and guidance.

PERSONNEL RESPONSIBILITIES(CONT.)

- Comply with the Pesticide Discharge Management Plan in the event of an emergency

  Note: In the event of an emergency, **Exhibits PEST-9008, PEST-9017,** and **PEST-9024** provide emergency contact information.

DIVISION OF MAINTENANCE	*Chapter* SAFETY
	*Subject* Personal Protective Equipment (PPE)

POLICY

Maintenance personnel shall adhere to the following provisions provided by the EPA's 40 Code of Federal Regulations Part 170 -- Worker Protection Standard.

EPA 40 CFR, PART 170.240

a) *Requirement*. Any person who performs tasks as a pesticide handler shall use the clothing and personal protective equipment specified on the labeling for use of the product.

b) *Definition*.

1) Personal protective equipment (PPE) means devices and apparel that are worn to protect the body from contact with pesticides or pesticide residues, including, but not limited to, coveralls, chemical-resistant suits, chemical-resistant gloves, chemical-resistant footwear, respiratory protection devices, chemical-resistant aprons, chemical-resistant headgear, and protective eyewear.

2) Long-sleeved shirts, short-sleeved shirts, long pants, short pants, shoes, socks, and other items of work clothing are not considered personal protective equipment for the purposes of this section and are not subject to the requirements of this section, although pesticide labeling may require that such work clothing be worn during some activities.

c) *Provision*. When personal protective equipment is specified by the labeling of any pesticide for any handling activity, the handler employer shall provide the appropriate personal protective equipment in clean and operating condition to the handler.

1) When "chemical-resistant" personal protective equipment is specified by the product labeling, it shall be made of material that allows no measurable movement of the pesticide being used through the material during use.

EPA 40 CFR,
PART 170.240 (CONT.)

2) When "waterproof" personal protective equipment is specified by the product labeling, it shall be made of material that allows no measurable movement of water or aqueous solutions through the material during use.

3) When a "chemical-resistant suit" is specified by the product labeling, it shall be a loose-fitting, one- or two-piece chemical-resistant garment that covers, at a minimum, the entire body except head, hands, and feet.

4) When "coveralls" are specified by the product labeling, they shall be a loose-fitting, one- or two-piece garment, such as a cotton or cotton and polyester coverall that covers, at a minimum, the entire body except head, hands, and feet. The pesticide product labeling may specify that the coveralls be worn over another layer of clothing.

5) (i) Gloves shall be of the type specified on the pesticide product labeling. Gloves made of leather, cotton, or other absorbent materials may not be worn while mixing, loading, applying, or otherwise handling pesticides, unless gloves made of these materials are listed as acceptable for such use on the product labeling.

   (ii) Separable glove liners may be worn beneath chemical-resistant gloves, unless the pesticide product labeling specifically prohibits their use. Separable glove liners are defined as separate glove-like hand coverings, made of lightweight material, with or without fingers. Work gloves made from lightweight cotton or poly-type material are considered to be glove liners if worn beneath chemical-resistant gloves. Separable glove liners may not extend outside the chemical-resistant gloves under which they are worn. Chemical-resistant gloves with non-separable absorbent lining materials are prohibited.

   (iii) If used, separable glove liners must be discarded immediately after a total of no more than 10 hours of use or within 24 hours of when first put on, whichever comes first. The liners must be replaced immediately if directly contacted by pesticide. Used glove liners shall not be reused. Contaminated liners must be disposed of in accordance with any Federal, State, or local regulations.

EPA 40 CFR,
PART 170.240 (CONT.)

6) When "chemical-resistant footwear" is specified by the product labeling, one of the following types of footwear must be worn:

   (i) Chemical-resistant shoes
   (ii) Chemical-resistant boots
   (iii) Chemical-resistant shoe coverings worn over shoes or boots

7) When "protective eyewear" is specified by the product labeling, one of the following types of eyewear must be worn:

   (i) Goggles
   (ii) Face shield
   (iii) Safety glasses with front, brow, and temple protection
   (iv) Full-face respirator

8) When a "chemical-resistant apron" is specified by the product labeling, an apron that covers the front of the body from mid-chest to the knees shall be worn.

9) When a respirator is specified by the product labeling, it shall be appropriate for the pesticide product used and for the activity to be performed. The handler employer shall assure that the respirator fits correctly.

10) When "chemical-resistant headgear" is specified by the product labeling, it shall be either a chemical resistant hood or a chemical-resistant hat with a wide brim.

d) *Exceptions to personal protective equipment specified on product labeling*

1) *Body protection*.

   (i) A chemical-resistant suit may be substituted for "coveralls," and any requirement for an additional layer of clothing beneath is waived.
   (ii) A chemical-resistant suit may be substituted for "coveralls" and a chemical-resistant apron.

2) *Boots*. If chemical-resistant footwear with sufficient durability and a tread appropriate for wear in rough terrain is not obtainable, then leather boots may be worn in such terrain.

EPA 40 CFR,
PART 170.240 (CONT.)

3) *Gloves*. If chemical-resistant gloves with sufficient durability and suppleness are not obtainable, then during handling activities with roses or other plants with sharp thorns, leather gloves may be worn over chemical-resistant glove liners. However, once leather gloves are worn for this use, thereafter they shall be worn only with chemical-resistant liners and they shall not be worn for any other use.

4) *Closed systems*. If handling tasks are performed using properly functioning systems that enclose the pesticide to prevent it from contacting handlers or other persons, and if such systems are used and are maintained in accordance with that manufacturer's written operating instructions, exceptions to labeling-specified personal protective equipment for the handling activity are permitted as provided in paragraphs (d)(4)(i) and (ii) of this section.

   (i) Persons using a closed system to mix or load pesticides with a signal word of DANGER or WARNING may substitute a long-sleeved shirt, long pants, shoes, socks, chemical-resistant apron, and any protective gloves specified on the labeling for handlers for the labeling-specified personal protective equipment.

   (ii) Persons using a closed system to mix or load pesticides other than those in paragraph (d)(4)(i) of this section or to perform other handling tasks may substitute a long-sleeved shirt, long pants, shoes, and socks for the labeling-specified personal protective equipment.

   (iii) Persons using a closed system that operates under pressure shall wear protective eyewear.

   (iv) Persons using a closed system shall have all labeling-specified personal protective equipment immediately available for use in an emergency.

5) *Enclosed cabs*. If handling tasks are performed from inside a cab that has a nonporous barrier which totally surrounds the occupants of the cab and prevents contact with pesticides outside of the cab, exceptions to personal protective equipment specified on the product labeling for that handling activity are permitted as provided in paragraphs (d)(5)(i) through (iv) of this section.

EPA 40 CFR,
PART 170.240 (CONT.)

(i) Persons occupying an enclosed cab may substitute a long-sleeved shirt, long pants, shoes, and socks for the labeling-specified personal protective equipment. If a respiratory protection device is specified on the pesticide product labeling for the handling activity, it must be worn.

(ii) Persons occupying an enclosed cab that has a properly functioning ventilation system which is used and maintained in accordance with the manufacturer's written operating instructions and which is declared in writing by the manufacturer or by a governmental agency to provide respiratory protection equivalent to or greater than a dust/mist filtering respirator may substitute a long-sleeved shirt, long pants, shoes, and socks for the labeling-specified personal protective equipment. If a respiratory protection device other than a dust/mist-filtering respirator is specified on the pesticide product labeling, it must be worn.

(iii) Persons occupying an enclosed cab that has a properly functioning ventilation system which is used and maintained in accordance with the manufacturer's written operating instructions and which is declared in writing by the manufacturer or by a governmental agency to provide respiratory protection equivalent to or greater than the vapor- or gas-removing respirator specified on pesticide product labeling may substitute a long-sleeved shirt, long pants, shoes, and socks for the labeling-specified personal protective equipment. If an air-supplying respirator or a self-contained breathing apparatus (SCBA) is specified on the pesticide product labeling, it must be worn.

(iv) Persons occupying an enclosed cab shall have all labeling-specified personal protective equipment immediately available and stored in a chemical-resistant container, such as a plastic bag. They shall wear such personal protective equipment if it is necessary to exit the cab and contact pesticide-treated surfaces in the treated area. Once personal protective equipment is worn in the treated area, it must be removed before reentering the cab.

EPA 40 CFR,
PART 170.240 (CONT.)

6) *Aerial applications*

(i) *Use of gloves*. The wearing of chemical-resistant gloves when entering or leaving an aircraft used to apply pesticides is optional, unless such gloves are required on the pesticide product labeling. If gloves are brought into the cockpit of an aircraft that has been used to apply pesticides, the gloves shall be kept in an enclosed container to prevent contamination of the inside of the cockpit.

(ii) *Open cockpit*. Persons occupying an open cockpit shall use the personal protective equipment specified in the product labeling for use during application, except that chemical-resistant footwear need not be worn. A helmet may be substituted for chemical-resistant headgear. A visor may be substituted for protective eyewear.

(iii) *Enclosed cockpit*. Persons occupying an enclosed cockpit may substitute a long-sleeved shirt, long pants, shoes, and socks for labeling-specified personal protective equipment.

7) *Crop advisors*. Crop advisors entering treated areas while a restricted-entry interval is in effect may wear the personal protective equipment specified on the pesticide labeling for early-entry activities instead of the personal protective equipment specified on the pesticide labeling for handling activities, provided:

(i) Application has been completed for at least 4 hours.
(ii) Any inhalation exposure level listed in the labeling has been reached or any ventilation criteria established by § 170.110(c)(3) or in the labeling have been met.

(e) *Use of personal protective equipment*.

(1) The handler employer shall assure that personal protective equipment is used correctly for its intended purpose and is used according to the manufacturer's instructions.

(2) The handler employer shall assure that, before each day of use, all personal protective equipment is inspected for leaks, holes, tears, or worn places, and any damaged equipment is repaired or discarded.

EPA 40 CFR,
PART 170.240 (CONT.)

(f) *Cleaning and maintenance*.

(1) The handler employer shall assure that all personal protective equipment is cleaned according to the manufacturer's instructions or pesticide product labeling instructions before each day of reuse. In the absence of any such instructions, it shall be washed thoroughly in detergent and hot water.

(2) If any personal protective equipment cannot be cleaned properly, the handler employer shall dispose of the personal protective equipment in accordance with any applicable Federal, State, and local regulations. Coveralls or other absorbent materials that have been drenched or heavily contaminated with an undiluted pesticide that has the signal word DANGER or WARNING on the label shall be not be reused.

(3) The handler employer shall assure that contaminated personal protective equipment is kept separately and washed separately from any other clothing or laundry.

(4) The handler employer shall assure that all clean personal protective equipment shall be either dried thoroughly before being stored or shall be put in a well-ventilated place to dry.

(5) The handler employer shall assure that all personal protective equipment is stored separately from personal clothing and apart from pesticide-contaminated areas.

(6) The handler employer shall assure that when dust/mist filtering respirators are used, the filters shall be replaced:

(i) When breathing resistance becomes excessive.

(ii) When the filter element has physical damage or tears.

(iii) According to manufacturer's recommendations or pesticide product labeling, whichever is more frequent.

(iv) In the absence of any other instructions or indications of service life, at the end of each day's work period.

EPA 40 CFR,
PART 170.240 (CONT.)

(7) The handler employer shall assure that when gas- or vapor-removing respirators are used, the gas- or vapor-removing canisters or cartridges shall be replaced:

(i) At the first indication of odor, taste, or irritation.

(ii) According to manufacturer's recommendations or pesticide product labeling, whichever is more frequent.

(iii) In the absence of any other instructions or indications of service life, at the end of each day's work period.

(8) The handler employer shall inform any person who cleans or launders personal protective equipment:

(i) That such equipment may be contaminated with pesticides.

(ii) Of the potentially harmful effects of exposure to pesticides.

(iii) Of the correct way(s) to clean personal protective equipment and to protect themselves when handling such equipment.

(9) The handler employer shall assure that handlers have a clean place(s) away from pesticide storage and pesticide use areas where they may:

(i) Store personal clothing not in use.

(ii) Put on personal protective equipment at the start of any exposure period.

(iii) Remove personal protective equipment at the end of any exposure period.

(10) The handler employer shall not allow or direct any handler to wear home or to take home personal protective equipment contaminated with pesticides.

EPA 40 CFR, PART 170.240 (CONT.)

(g) *Heat-related illness*. When the use of personal protective equipment is specified by the labeling of any pesticide for the handling activity, the handler employer shall assure that no handler is allowed or directed to perform the handling activity unless appropriate measures are taken, if necessary, to prevent heat-related illness.

FURTHER PPE GUIDANCE

For more information concerning PPE, see *University of Kentucky Cooperative Extension PAT-6: Personal Protective Equipment for Pesticide Applicators* (**Exhibit PEST-9015**) and the *Employee Safety and Health Manual* or contact the Employee Safety and Health Branch at (502) 564-4610.

SUPPLIERS OF SAFETY EQUIPMENT

Exhibit PEST-9025 provides a list of recommended suppliers.

DIVISION OF MAINTENANCE	*Chapter*
	SAFETY
	Subject
	Pesticide Contact & Exposure

PESTICIDE OVEREXPOSURE

Cabinet employees working with any kind of pesticide shall have a plan to follow in case of accidental overexposure that includes both immediate first-aid treatment and a follow-up course of action.

First-aid procedures are just that—the first response. Sometimes first aid will take care of the problem; however, other situations will require professional medical help. Specific treatment varies with the type of exposure.

PROTECTING THE BODY

Pesticides can enter the body in three major ways:

- Mouth (oral)
- Skin or eyes (dermal)
- Lungs (inhalation)

Oral exposure can be caused by accidentally splashing pesticides into the mouth by eating, drinking, or smoking without washing hands after handling pesticides or by mistaking the pesticides for food or drink. For this reason, employees shall never transfer a pesticide out of its original labeled container into a container that has held food or drink.

Dermal exposure can be caused by splashing pesticides on unprotected skin or into the eyes by not washing hands after touching pesticides or containers, by not wearing protective clothing while mixing pesticides, or by continuing to wear clothing after it has been contaminated with a pesticide. Sensitive body areas such as the eyes absorb more pesticide than do the hands.

Inhalation exposure can be caused by breathing pesticide vapors in close or poorly ventilated places during mixing and handling.

PEST-302 provides more information on personal protective equipment.

PESTICIDE ON THE SKIN

The sooner the pesticide is washed off the patient, the less the injury.

1. Remove clothing and drench skin with water (shower, hose, faucet, pond, ditch, etc.)

2. Cleanse skin and hair thoroughly with soap and water. (Don't abrade or injure the skin while washing.)

3. Dry and wrap in a blanket.

WARNING: Do not allow any of the pesticide to get on you while helping the victim.

CHEMICAL BURNS OF THE SKIN

When encountering a chemical burn on the skin:

1. Remove contaminated clothing

2. Wash the skin with large quantities of cold running water.

WARNING: Avoid use of ointments, greases, powders, and other drugs in first-aid treatment of chemical burns.

PESTICIDE IN THE EYE

It is very important to wash the eye out as quickly, but as gently, as possible.

1. Hold eyelids open, wash eyes with a gentle stream of clean running water at body temperature.

2. Continue washing for 15 minutes or more.

WARNING: Do not use chemicals or drugs in wash water, as they may increase the extent of the injury.

INHALED PESTICIDES (DUST, VAPORS, GASES)

If the victim is in an enclosed area, use an air-supplied respirator.

Carry victim (do not let victim walk) to fresh air immediately.

1. Open all doors and windows.

2. Loosen all tight clothing.

3. Apply artificial respiration if breathing has stopped or is irregular.

4. If victim is convulsing, watch breathing and protect victim from falling or striking their head. Pull victim's chin forward so tongue does not block air passageway.

5. Prevent chilling (wrap victim in blankets, but don't overheat)

WARNING: Do not give alcohol in any form.

INGESTED PESTICIDE

The most important decision to make when aiding a person who has swallowed a pesticide is whether to induce vomiting or not. The decision must be made quickly and accurately. The victim's life may depend on it. Usually it is best to get rid of the swallowed pesticide fast, but **NEVER** induce vomiting if the victim is unconscious or is in convulsions. The victim could choke to death on the vomitus.

Find out what pesticide has been ingested. **NEVER** induce vomiting if the victim has swallowed a corrosive pesticide. A corrosive is a strong acid or alkali (base) such as dinoseb (DN Compounds). The victim will complain of severe pain and have signs of severe mouth and throat burns. A corrosive pesticide will burn the throat and mouth as severely coming up as it did going down.

Most labels on emulsifiable concentrate and solution formulations suggest the victim should not have vomiting induced. However, when the toxicity of the pesticide is marked, its removal may be essential.

PEST-304 provides more information on how to induce vomiting.

DIVISION OF MAINTENANCE	*Chapter*
	SAFETY
	Subject
	Induce Vomiting

PROCEDURE

Give one tablespoon (1/2 ounce) of syrup of ipecac to a child over one year of age or one fluid ounce (two tablespoons) to an adult, followed by a glass of water. Do not waste a lot of time waiting for the vomiting to commence. Do not let victim lie on back because vomitus could enter the lungs and do more damage. Catch the vomitus in a container and save for a doctor if chemical testing is required.

An ounce of syrup of ipecac may be obtained without a prescription from a pharmacist.

If syrup of ipecac is unavailable, give one cup of milk or water for victims up to five years of age or one to two glasses for victims five years and older. Induce vomiting by putting a finger or the blunt end of a spoon on the very back of the tongue. **Do not use anything that is sharp or pointed.**

A glass of soapy water (such as Ivory soap from a bar dissolved in water) may also cause the victim to vomit.

DIVISION OF MAINTENANCE	*Chapter*
	SAFETY
	Subject
	Personal Cleanup

PERSONAL CLEANUP

Guidelines to follow on personal cleanup are:

- Wash hands and face thoroughly before eating, drinking, or smoking.
- At the end of each day always remove all clothing and wash them before wearing them again.
- Take a bath, preferably a good hot shower, at the end of each working day.
- Clothing should be washed separately from family laundry in case someone may have sensitive skin.
- Do not let children play in clothing before it is laundered.
- Carry a water source and soap on each spray unit.

If a pesticide is splashed into eyes, gently wash with clean water immediately.

DIVISION OF MAINTENANCE	*Chapter*
	PESTICIDE USE & CONTROLS
	Subject
	Storage of Pesticides

POLICY

Maintenance personnel shall store pesticides:

- In an area separate from the office and from seed and fertilizer storage areas

  Note: A sign shall be posted on the doors to identify pesticide storage areas stating "PESTICIDE STORAGE" or "WARNING PESTICIDES" (**Exhibit PEST-9022**).

- In their original container as labeled

  Note: If a pesticide's packaging becomes deteriorated due to shipping damage or extended storage, maintenance personnel shall contact the Division of Environmental Services in the Department of Agriculture. Their instructions on repackaging the pesticide product and any necessary cleanup shall be followed explicitly.

DIVISION OF MAINTENANCE	*Chapter*
	PESTICIDE USE & CONTROLS
	Subject
	Mixing Pesticides

POLICY

Maintenance personnel shall mix pesticides in accordance with label directions and shall be licensed and certified.

Maintenance personnel shall wear the following protective equipment when mixing a pesticide:

- Liquid-proof gloves
- A hat or hood to cover the head
- Goggles or face shield to protect the eyes
- Liquid-proof apron

Exhibit PEST-9012 details the mixing procedure for filling herbicide spray tanks.

DIVISION OF MAINTENANCE	*Chapter* PESTICIDE USE & CONTROLS
	*Subject* Applying Pesticides

OVERVIEW

The following is an adaptation from the Kentucky Cooperative Extension Service CORE Manual, *Applying Pesticides Correctly: A Guide for Private and Commercial Applicators*.

One of the most important tasks for a pesticide applicator is making sure that the correct amount of pesticide is being applied to the target site.

For each pesticide application, take the time to determine how much you need to apply. Then be sure that you apply the correct amount.

Underdosing is expensive. If you apply too little pesticide, you may not fully control the pest. Sometimes you can repeat the entire application but that can be very costly in both time and money. In other cases, a repeat application may not be possible because it would result in an overdose.

Overdosing is expensive because of the high cost of pesticides. Do not use any more than the amounts listed in the *Directions for Use* section of the pesticide labeling. Using more product than the labeling recommends will not do a better job of controlling pests, and it is illegal. Overdosing may cause damage or injuries, leave illegal residues, and cause you to be fined or to be liable for damages.

DECIDING HOW MUCH TO APPLY

Study the *Directions for Use* section of the pesticide labeling to find out how much pesticide you should apply. If the labeling lists a range of possible amounts, use the least amount that will achieve good control. Sometimes consultants, industry organizations, pest or pesticide specialists, Cooperative Extension agents, university specialists, or pesticide dealers will recommend appropriate amounts.

DECIDING HOW MUCH TO APPLY (CONT.)

The amount of pesticide to use is expressed in various ways. Application rates may be expressed in terms of how much pesticide formulation should be applied. The instructions may tell you how much pesticide formulation should be applied to each unit of area or volume in the target site—5 fluid ounces of formulation per acre or 1 pound of formulation per 100 cubic feet of space, for examples.

Application rates also may be expressed in terms of how much **pesticide formulation** should be used per volume of mixture. Labeling might call for 3 tablespoons of product per 5 gallons of water or 1 pint of product per 100 gallons of water.

Sometimes pesticide labeling and other sources express application rates in terms of how much **active ingredient** should be applied per unit of area or per volume of mixture. When the application rate is expressed in this way, you can select different formulations and be able to figure how much to dilute each one. However, figuring the correct dilution for active ingredient recommendations is more complicated.

Occasionally, the application rate is expressed in terms of a **percentage of the final dilution**—for example, 0.5% by volume or 1% by weight. Products that are adjuvants often express the application rate in this way. Expressing application rate as a percentage allows the user to calculate the dilution correctly, for whatever dilution method is being used for the formulation.

Studies indicate that only one out of four pesticide applications is applied within an acceptable range of the intended rate. Applying either too little or too much pesticide can cause problems.

Exhibit PEST-9003 provides a list of common conversions.

MIXING, LOADING, & CALIBRATION ALTERNATIVES

Knowing what amount of the pesticide you must apply is only the first step. Next, you must determine how you will deliver the correct amount to the target site. Depending on the type of formulation you choose and the type of application equipment you will use, you may have to do some combination of three basic tasks—mixing the pesticide, loading it into your equipment, and calibrating the equipment so you will know exactly how much pesticide it is delivering.

MIXING, LOADING, & CALIBRATION ALTERNATIVES (CONT.)

- **Mixing**—Unless the pesticide is a ready-to-use formulation or is designed to be applied full strength, you must carefully combine the right amounts of concentrated pesticide formulation and diluents to make the needed application-strength pesticide mixture.

- **Loading**—You need to transfer the pesticide into the equipment before it can be applied.

- **Calibrating**—For many kinds of applications, you must measure and adjust the amount of pesticide your equipment will apply to the target site.

Each different combination of formulation and equipment type requires you to do a different combination of these tasks to prepare for applying a measured amount of pesticide.

CALIBRATING YOUR EQUIPMENT

Most pesticide applications involve equipment that must be measured and adjusted to release the correct amount of pesticide to the target site. Proper calibration is an essential but often neglected task.

To be sure your equipment is releasing the right amount of pesticide, take time to calibrate it carefully and correctly. Recheck it regularly to detect changes caused by wear, corrosion, and aging.

Calibration often requires some simple arithmetic. Usually the equipment manufacturer, the pesticide dealer, your industry organization, or the Cooperative Extension Service will provide some standard formulas to help you. The easiest and most accurate way to do the calculations is with a calculator.

Choose equipment that you know how to use and that is designed for the type of chemical being applied, and appropriate for the size and type of application job.

Equipment will not deliver the right amount of pesticide to the target site if it is not working correctly. Before you begin to calibrate the equipment, check it carefully to be sure that all components are clean and in good working order. Pay particular attention to the parts that regulate the amount of pesticide being released, such as nozzles and hopper openings. If they become clogged, not enough pesticide will be released. If they become worn, too much pesticide will be released.

CALIBRATING YOUR EQUIPMENT (CONT.)

Equipment that must be calibrated includes mechanical dusters; granule spreaders; hand, backpack, boom, handgun, high-pressure, air blast, and most other sprayers; and fumigant applicators. The many types of application equipment differ in the details of their operation, but if you understand the basic principles of calibration, you can apply them in any situation.

Study the manufacturer's instructions carefully—they explain exactly how to adjust the equipment. They often contain suggestions on such things as the appropriate rate of travel, the range of most efficient pump pressures, approximate settings for achieving various delivery rates, and types of nozzles that can be used.

SPEED

For some application equipment, the speed at which the equipment moves (or is carried) through the target site is one of the main factors determining application rate. For other equipment, speed is not a factor.

Equipment with gravity-flow dispersal. If the equipment you have chosen uses gravity to maintain the flow of pesticide, calibration may be simple. Some equipment, such as some granule spreaders, needs to be calibrated only to adjust the rate of flow or delivery. This equipment releases pesticide only when the wheels are in motion. If the equipment speed is kept at an even, moderate pace, the amount of pesticide being released per unit area will be uniform.

Equipment with powered dispersal. If your equipment has a pump or other mechanism to disperse the pesticide, you will need to determine the rate of speed best suited for the type of equipment and for the particular requirements of your application job. Such equipment may be either hand-carried or mounted on a vehicle.

The speed at which the equipment moves through the target site determines the amount of pesticide applied in a given area. Keep the speed as constant as possible during the calibration process and during the actual application. For the most accurate calibration, operate the equipment at the target site or on ground (or other surface) similar to that at the target site.

Whether the equipment is hand-carried or mounted on a vehicle, the condition of the ground (surface) that must be crossed is important. A rough and uneven surface will cause the equipment to be operated at a slower speed.

UNIFORM RELEASE

If your application equipment has more than one nozzle (or more than one cluster of nozzles) or hopper, part of the calibration process is to measure the output from each to be sure that they are releasing a uniform amount of pesticide.

First, check for clogging or obstructions, leaks, or worn nozzles. Then, measure the pesticide output for each nozzle (or cluster of nozzles) or hopper for a specific period. The output must be within 10% of the average of the nozzles (or cluster of nozzles) or hoppers. Finally, replace worn or damaged nozzles or hoppers if the output is beyond 10% of the average.

You can check for uniform output in two ways. Either method requires that you attach containers to collect the output from each nozzle, nozzle cluster, or hopper.

1. Operate the equipment for a set period and compare the amount of output in each container to the amount desired.

2. Operate the equipment over a measured area while calibrating the equipment and, at the end of the calibration run, compare the amount of output in each container to the amount desired. If all the nozzles or hoppers are intended to release an equal amount of pesticide, just check to see whether all the containers contain the same amount.

CALIBRATION METHODS

No matter what calibration method you use, you will be measuring how much pesticide is being applied in a specific area. Calibration usually requires you to operate the equipment over a premeasured distance.

The rate of application depends partly on the particle or droplet size, texture, and other properties of the pesticide being applied, so you will need to decide what material to use in the test. If the pesticide is a liquid with water as the major diluent, use water alone in the test. If the pesticide is a dust, granule, or fumigant or a liquid diluted with a liquid other than water, you must use the actual pesticide in the test.

The rate of application sometimes depends also on the pressure and on the nozzle size or hopper opening. The equipment manufacturer's directions are the best guide to these selections.

DO A TEST APPLICATION

Calibrate your application equipment by:

- Accurately measuring the amount in the tank or hopper
- Operating the equipment over the premeasured distance while maintaining your chosen speed (if speed affects the delivery rate of the equipment you are using)
- Accurately measuring the amount needed to fill the tank or hopper back up to the pre-application level
- If multiple nozzles or hoppers are used, adding the output of all the collection jars

FIGURE THE APPLICATION RATE

The amount of pesticide dispersed, divided by the distance covered, is the application rate. Sometimes no calculations are needed. If, for example, the label lists the application rate as "per acre" or "per 1,000 linear feet" and you measure the output for exactly 1 acre or exactly 1,000 linear feet, no calculations are necessary because the amount of output you measured is the amount required.

However, you may not have time to test your equipment over such a large site. Alternatively, if you are using the actual pesticide in the test, you may not want to risk applying it over a large site without knowing the application rate. Under these conditions, test smaller sites and then calculate the application rate.

CHECK CALIBRATION OFTEN

Once you have calibrated your equipment, do not assume that it will continue to deliver the same rate during all future applications. Clogging, corrosion, and wear may change the delivery rate, or the settings may gradually get out of adjustment. Take time to check the calibration regularly.

Be alert for possible calibration problems each time you use application equipment. During the application, notice whether you are treating the same amount of area per load that you figured. If you find that you are covering more or less area, stop the application and check your figures and your equipment. If you have figured wrong or if your application equipment changes its delivery rate, you will be able to catch the mistake before you have a major problem.

MEASURE ACCURATELY

Inaccurate measurements can lead to underdosing, overdosing, too much pesticide mixture left in the tank, or a tank load of the wrong strength of pesticide mixture.

Use marked or graduated utensils. If you are measuring a dry formulation, use a scale to weigh out the exact number of pounds or ounces you need. For a liquid formulation or diluent:

- Use measuring spoons or a "tip and pour" to measure teaspoons or tablespoons
- Use a graduated measuring cup or a "tip and pour" to measure from 1/4 cup to 1 pint
- Use a graduated jug or pail to measure from 1 pint to 5 gallons
- Use a flow meter to measure more than 5 gallons at a time

Carefully measure the amount of pesticide to add. Do not guess how much you are adding and do not add a little extra "just to be sure." Also, measure the amount of diluent carefully. Adding the correct amount of concentrate to an approximated amount of diluent can result in a whole tankful of the wrong strength of pesticide mixture. Mix only the amount you have calculated for the application.

Do not assume that the tank is exactly the size of its claimed capacity. A "5 gallon" tank may hold more or less than 5 gallons. A "100 gallon" tank often holds quite a bit more than 100 gallons when totally filled.

Measure the tank yourself to be sure. Even the graduated marks on some tanks or hoppers that indicate levels of partial fill are often inaccurate.

You can measure the capacity of your tank and check (or make) gauges indicating partial fill levels in two ways. You can fill the tank by hand using a container of known capacity, such as a measuring cup for small tanks and a 5-gallon pail for larger tanks. Or you can attach a flow meter to a hose and measure the quantity of water as it flows into the tank. For either method, as you fill the tank, you should check or mark measured volumes on a dipstick or sight gauge.

MEASURE ACCURATELY (CONT.)

If water or another liquid is being used to dilute the concentrate, rinse the measuring utensils with the diluent and put the rinsate into the mix tank. Repeat this three times to be sure all of the pesticide is removed from the measuring utensil.

Measuring utensils that you use with pesticides should never be used for other purposes. Clean them thoroughly after each use and store them with other pesticide equipment.

DETERMINING SIZE OF TARGET SITE

If the target site is a rectangle, circle, or triangle, you can use simple measurements and formulas to determine its size. Irregularly shaped sites often can be reduced to a combination of rectangles, circles, and triangles. Calculate the area of each and add them together to obtain the total area.

To apply fumigants and a few other pesticides to fill the entire inside of a structure or other enclosed space, you must calculate the volume (cubic feet) of the building, greenhouse, truck, railroad car, or ship hold.

To apply pesticides to bodies of water (not just the surface), you must calculate the volume of the water in the pond or lake. Sometimes the structures or bodies of water are regular in shape. The calculations for these are simple. If the structure or body of water is irregular, you must calculate parts of the structure separately and add them together to find the total volume.

Exhibit PEST-9002 provides equipment calibration examples.

DIVISION OF MAINTENANCE	*Chapter*
	PESTICIDE USE & CONTROLS
	Subject
	Loading Pesticides

POLICY

When loading pesticides:

- Use protective clothing. **PEST-302**, "Personal Protective Equipment," provides more information.
- Mix and prepare spray loads in the open air or in a well-ventilated place.
- Avoid inhaling fumes or mists.
- Open the pesticide container carefully to avoid spilling.
- Make sure there is no chance of contaminating food, feed, or water.
- Do not eat, drink, or smoke while loading pesticides.
- Keep children and pets away from loading area.
- Accurately measure the amount of pesticide to be used.
- Always keep a pesticide in its original labeled container.
- Rinse measuring containers after use and pour rinsate into spray tank.
- Follow the procedures in **PEST-406** for the proper disposal of pesticide containers.
- Keep the pesticide concentrate away from skin, eyes, mouth, nose, and clothing. If concentrate is spilled on the skin, wash with plenty of soap or detergent and water. **PEST-303** provides more information on pesticide contact and exposure. See a physician if necessary.

DIVISION OF MAINTENANCE	*Chapter* PESTICIDE USE & CONTROLS
	*Subject* Transporting Pesticides

AUTHORITY

The Department of Agriculture promulgates administrative regulations to establish requirements for the storage and handling of pesticides. 302 KAR 28:020 Section 3 (4) "Standards for transportation of pesticides" states:

> *All pesticides transported on or in vehicles owned or operated by dealers, pesticide operators, pesticide applicators, or noncommercial applicators shall be transported consistent with 49 USC 51.*

The Kentucky Division of Water has issued a KPDES permit (KYG99) entitled, "General Permit for Pesticide Application" to KYTC and it is implemented with a "Pesticide Discharge Management Plan" for each District, which includes additional requirements for the use of Pesticide Sprayer Vehicles that transport and apply pesticides. Such items as specified Spill kits, shovels, personal protective equipment, spill response Notification cards and spill prevention guidelines are included in the PDMP for each district.

PROCEDURES

Maintenance personnel shall:

- Examine all pesticide containers for damage and leaks before transporting
- Safely secure all containers in the truck before transporting
- If the truck has an open bed, make sure the tailgate is up and fastened so the pesticides cannot roll out the back

VEHICLE & EQUIPMENT

Chapter 14 of the Transportation Cabinet's *Employee Safety and Health Manual* provides additional guidance on the vehicles and equipment required for transporting pesticides.

DIVISION OF MAINTENANCE	*Chapter*
	PESTICIDE USE & CONTROLS
	Subject
	Disposal of Pesticide Containers

POLICY

Maintenance personnel shall:

- Triple rinse empty pesticide containers with the rinse solution (rinsate) being poured into the spray tank

  Note: **Exhibit PEST-9020** provides more information.

- Crush or puncture the containers
- Recycle the containers through the Kentucky Department of Agriculture's Rinse and Return Program or dispose of in a landfill
- Take the containers to an approved sanitary landfill
- Never reuse containers

  Note: **Exhibit PEST-9006** provides information on decontamination of spray tanks.

RECYCLING CONTAINERS

Refer to U.S. Environmental Protection Agency (EPA) for guidelines on pesticide container recycling.

DIVISION OF MAINTENANCE	*Chapter*
	PESTICIDE USE & CONTROLS
	Subject
	Pesticide Spills

POLICY

The Kentucky Division of Water has promulgated regulations requiring a KPDES permit (KYG99) and a PDMP for each district which includes 'Spill Response Procedures'. These include Spill Containment, Spill Notification and using OSHA (29CFR1910.120) trained Spill Response Contractors to cleanup pesticide spills.

A pesticide spill is that condition where an amount of a pesticide product concentrate or tank mix solution greater than the label-recommended application rate has been spilled onto a surface area. The Pesticide Discharge Management Plan book details spill response procedures.

- **Minor Spill**—Condition where 5 gallons or less of a pesticide product concentrate or 25 gallons or less of a pesticide tank mix has been spilled. This type of spill may be cleaned up by washing off or applying an absorbent-type material.

- **Major Spill**—Condition where large areas or volumes of concentrate are involved. In the event of a spill of this type, onsite district personnel shall:

  1. Take action to stop or contain the spill

  2. Keep people away

  3. Contact the roadside environment district administrator (**Exhibit PEST-9024**)

  4. Contact the Roadside Environment Branch staff of the Division of Maintenance.

  5. Call state police or sheriff (See Kentucky State Police Posts, **Exhibit PEST-9011**)

  6. Send a written report through the CDE to the Division of Maintenance after the spill has been cleaned

EMERGENCY CONTACTS

Exhibit PEST-9017 provides a list of pesticide emergency contacts.

Exhibit PEST-9008 provides a list of the Environmental Protection Agency (EPA) Regional Offices.

DIVISION OF MAINTENANCE	*Chapter*
	PESTICIDE USE & CONTROLS
	Subject
	Pesticide Waste Reduction

GUIDELINES

The following guidelines will aid maintenance personnel with the pesticide application plan to reduce pesticide waste before, during, and after application.

Maintenance personnel should:

- Determine the necessity of pesticide use and what, if any, alternatives can be used to avoid pesticide application
- Check with the appropriate OMS coordinator before purchasing unnecessary pesticide materials into inventory and ensure pesticides are stored properly
- Rotate stock to ensure older, discontinued products are used up first
- Contact the Kentucky Department of Agriculture for disposal of banned or obsolete pesticide products
- Always follow label instructions and apply as recommended
- Calculate necessary amounts of mixture needed for application
- Follow proper container rinsing procedures immediately following application

  Note: **Exhibits PEST-9006** and **PEST-9020** provide additional information.
- Dispose of empty containers per Environmental Protection Agency (EPA) requirements

Note: **Exhibit PEST-9009**, "*How to Reduce Pesticide Waste"* provides further details.

DIVISION OF MAINTENANCE	*Chapter*
	PESTICIDE USE & CONTROLS
	Subject Eliminating Pesticide Exposure to Groundwater

OVERVIEW

Pesticide leaching can create an expensive, time-consuming, and usually permanent impact on the environment. Maintenance personnel should consider several factors before conducting pesticide applications. These factors include:

- Soil Characteristics
- Site Conditions
- Pesticide Properties
- Management Practices

These factors may increase or reduce the risk of pesticide exposure to groundwater. Knowing the effects of leaching and necessary preventive actions will help maintenance personnel develop a better pesticide application plan.

PREVENTIVE MEASURES

Cabinet employees shall:

- Consider environmental impact
- Apply pesticides only when necessary
- Follow label instructions and stay within recommended application rates
- Ensure equipment is properly maintained and calibrated
- Select and use pesticides with low susceptibility to leaching
- Prevent spills and properly dispose of unused pesticides and empty containers
- Spray pesticides under favorable weather conditions
- Store away from water sources

DIVISION OF MAINTENANCE	*Chapter*
	PESTICIDE USE & CONTROLS
	Subject
	Drift Management

DEFINITION

The Environmental Protection Agency (EPA) defines pesticide spray drift as "the physical movement of a pesticide through air at the time of application or soon thereafter, to any site other than that intended for application (often referred to as off target)."

IMPACT

Pesticide drift may be influenced by weather conditions, application site, equipment type and sprayer methods, and applicator techniques. Drift can cause environmental contamination, damage off-target sites, decrease effectiveness of pesticide to its intended site, increase pesticide waste, and be cost ineffective.

PERSONNEL RESPONSIBILITY

To guard against the movement of pesticides, maintenance personnel shall:

- Read and follow label instructions before applying pesticides
- Monitor weather conditions to determine if wind velocity, humidity, and temperature are conducive to pesticide application
- Ensure equipment is properly calibrated and pressure and nozzle settings are accurate for proper application
- Utilize drift reducing spray nozzle systems and anti-drift adjuvants
- Locate vegetation that is susceptible to drift and apply pesticides when winds are light
- Maintain detailed records using the TC 71-108 form, *Pesticide Field Report* (**Exhibit PEST-9018**)

Note: **Exhibit PEST-9007**, "*Drift Management*," provides more information.

DIVISION OF MAINTENANCE

Chapter

PESTICIDE USE & CONTROLS

Subject

Eliminating Pesticide Discharges into Surface Waters

Overview: Pesticide application in and near Surface Waters of the Commonwealth are regulated in KYG99 and are included in each district PDMP. Section 3.4 "Water Quality Standards" addresses these Surface Waters including the Special Use Waters (SUW) with county maps and guidelines for protecting these waters from Pesticide Discharges. This is in response to the KPDES permit regulation dealing with Kentucky's Anti-degradation policy.

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
	*Subject* Musk Thistle (Nodding Thistle)

COMMON & SCIENTIFIC NAMES

Musk Thistle (*Carduus nutans* L.)

SYNONYMS

Nodding thistle

PLANT HABITAT & LIFE HISTORY

An erect course biennial, rarely annual, herb 0.5–2 meters tall; native of Europe and western Asia

VEGETATIVE CHARACTERISTICS

- **Seedling**—Basal rosette; waxy pale green leaves with prominent vines; coarsely lobed leaves with 3–5 points per lobe
- **Roots**—Large, fleshy, corky, and hollow taproot near soil surface
- **Stems**—Erect, branched with spiny lobed leaves extending down stem (winged appearance); spine at tip of each lobe
- **Leaves**—Alternate; dark green with light green midribs and white margins; 15–40 centimeters long and 5–12 centimeters wide; deeply lobed with 3–5 points per lobe; prominent white or yellow 2–5-millimeter spines on each lobe

SPECIAL IDENTIFYING CHARACTERISTICS

Coarsely lobed leaves with spines on each lobe; erect stem with winged leaf-like spine appearances; solitary nodding heads and conspicuously broad (2–8 millimeters), long flat or reflexed, spine-pointed tips

REPRODUCTIVE CHARACTERISTICS

- **Flowers**—Mostly solitary heads that nod at end of branches; 30–50 millimeters thick; disk flowers deep rose to violet or purple; involucres bracts often tinged purple; conspicuously broad (2–8 millimeters), long flat or reflexed, spine-pointed tips
- **Fruit**—Ashen; straw-colored; oblong; glabrous; 5–10 nerved or nerveless; protrusion at attachment of plumeless pappus; whitish pappus
- **Seed**—Same as fruit

DISTRIBUTION

Rare in Midwest and southern U.S. and found in pastures, roadsides, meadows, and waste areas. Musk thistle prefers alluvial soils.

VISUALS

SEEDS

Courtesy of: California Department of Food & Agriculture

FLOWER

Courtesy of: California Department of Food & Agriculture

FULL PLANT VIEW

Courtesy of: California Department of Food & Agriculture

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
PESTICIDE MANUAL	*Subject* Canada Thistle

COMMON & SCIENTIFIC NAMES Canada Thistle [*Cirsium arvense (*L.) Scop.]

SYNONYMS Creeping thistle

PLANT HABITAT & LIFE HISTORY An upright growing perennial thistle; 0.6–1.5 meters tall; introduced and naturalized from Eurasia

VEGETATIVE CHARACTERISTICS

- **Seedling**—Cotyledons club-shaped, 16 millimeters long and 8 millimeters wide; first leaves also club-shaped, coarse, serrate margin with spines on tops of serration
- **Roots**—Extend up to 1 meter into the soil with extensively creeping horizontal growth
- **Stems**—0.6–1.5 meters tall; grooved; branching at top; glabrous early but hairy with maturity
- **Leaves**—Alternate; sessile; slightly clasping; simple; oblong to lanceolate; lobed with crinkled edges and spiny margins

SPECIAL IDENTIFYING CHARACTERISTICS A perennial thistle with small (2.5 centimeter diameter) rose-purple flowers and plants forming patches due to horizontal, perennial roots.

REPRODUCTIVE CHARACTERISTICS

- **Flowers**—In heads; dioeciously (male and female flowers on separate plants); numerous; 2–2.5 centimeters in diameter; compact in terminal clusters with lavender, rose-purple, or white disk flowers only. In involucres bracts numerous; spineless.
- **Seed**—Brown; smooth-coated; slightly tapered; 4.5 millimeters long with ridge around blossom end; attached to pappus that is easily broken off

DISTRIBUTION Throughout the northern half of the United States

VISUALS

SEEDS

Courtesy of: California Department of Food & Agriculture

LEAVES

Courtesy of: California Department of Food & Agriculture

FEMALE FLOWER

Courtesy of: California Department of Food & Agriculture

VISUALS (CONT.)

MALE FLOWER

Courtesy of: California Department of Food & Agriculture

FULL PLANT VIEW

Courtesy of: California Department of Food & Agriculture

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
PESTICIDE MANUAL	*Subject* Johnson Grass

COMMON & SCIENTIFIC NAMES Johnson grass [*Sorghum halepense (*L.) Pers.]

SYNONYMS None

PLANT HABITAT & LIFE HISTORY Coarse; perennial from thick scaly underground rhizomes; to 3.5 meters tall; introduced native of southern Eurasia, east to India

VEGETATIVE CHARACTERISTICS

- **Seedling**—Leaf sheaths and leaves glabrous; fringed membranous ligules
- **Roots**—Fibrous, thick rhizomes present
- **Stems**—Erect stems to 3.5 meters tall
- **Leaf**:
  - **Blade**—20–60 centimeters long, 10–30 millimeters wide, glabrous
  - **Ligules**—2–5 millimeters long, prominent membrane with fringe of hairs
  - **Sheath**—Open, glabrous except a few hairs at mouth on some plants

SPECIAL IDENTIFYING CHARACTERISTICS Thick scale-like rhizomes

REPRODUCTIVE CHARACTERISTICS

- **Seed Head**—An open panicle 15–50 centimeters long with numerous whorled branches
- **Spikelets**—2-flowered, 2 fertile and sessile, the other pedicelled, and male or neuter
  - **Fertile**—4–5.5 millimeters long
  - **Neuter**—4–6.5 millimeters long

REPRODUCTIVE CHARACTERISTICS (CONT.)

- **Glumes**—Equal to floret, hairy
- **Lemma**—Thin
- **Palea**—Thin, awned, awn 5–13 millimeters long or absent
- **Seed Unit**—Usually the hulled caryopsis, dark reddish- brown

DISTRIBUTION

A common weed on roadsides, ditches, cultivated fields, and waste places from Massachusetts to Iowa, south to Florida and Texas to southern California

VISUALS

SEEDS

Courtesy of: California Department of Food & Agriculture

VISUALS (CONT.)

SEED HEAD

Courtesy of: California Department of Food & Agriculture

FIELD VIEW

Courtesy of: California Department of Food & Agriculture

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
	*Subject* Giant Foxtail

COMMON & SCIENTIFIC NAMES Giant Foxtail (*Setaria faberi* Herrm.)

SYNONYMS Chinese millet

PLANT HABITAT & LIFE HISTORY Tufted, erect summer annual to 2 meters tall; introduced native of southeast Asia

VEGETATIVE CHARACTERISTICS

- **Seedling**—Hairy leaf sheath margins; upper side of leaves hairy; fringed membranous
- **Roots**—Fibrous
- **Culms**—Bent at nodes; rarely branching; glabrous to 1.2 meters tall
- **Leaf**:
  - **Blade**—10–30 centimeters long, 3–20 millimeters wide, hairy on upper side only
  - **Ligules**—A membrane fringed with hairs, 1.5–2 millimeters long
  - **Sheath**—Glabrous except on margins

SPECIAL IDENTIFYING CHARACTERISTICS Conspicuous nodding panicle, hairy upper leaf structure

REPRODUCTIVE CHARACTERISTICS

- **Seed Head**—A spike-like panicle, 5–20 centimeters long, 1–2.5 centimeters wide, cylindrical, nodding
- **Spikelets**—2.5–3 millimeters long, 1.2–1.5 millimeters wide, subsessile, 3–6 bristles below each spikelet, bristles up to 1 centimeter long

REPRODUCTIVE CHARACTERISTICS (CONT.)

- **Glumes**:
  - First, to 1 millimeter long
  - Second, to 2.2 millimeters long
- **Lemma**—Equaling the spikelet
- **Palea**—Equaling the spikelet, strongly wrinkled
- **Seed Unit**—Grain shed with glumes attached

DISTRIBUTION Massachusetts to Nebraska in the U.S. corn belt, south to northern Mississippi

VISUALS

SEEDS

Courtesy of: California Department of Food & Agriculture

SEED HEAD

Courtesy of: California Department of Food & Agriculture

VISUALS
(CONT.)

MATURE HEAD

Courtesy of: California Department of Food & Agriculture

FIELD VIEW

Courtesy of: California Department of Food & Agriculture

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
	*Subject* Marestail

COMMON & SCIENTIFIC NAMES Marestail (*Conyza canadensis* L.)

SYNONYMS Horseweed, Fleabane

PLANT HABITAT & LIFE HISTORY An annual plant to 2 meters tall; native to North America

VEGETATIVE CHARACTERISTICS

- **Seedling**—Oval- to egg-shaped cotyledons; hairless to densely covered with short hairs and up to 3 millimeters long; alternate leaves
- **Roots**—Taproot
- **Fruit**—1.5 millimeters long, narrow, elliptical
- **Seeds**—Enclosed in the achene, small
- **Stems**—Erect, simple, unbranched below, branched at inflorescence
- **Leaf**—Alternates, blades simple, numerous, crowded on stem, linear to oblanceolate, surface hairless

SPECIAL IDENTIFYING CHARACTERISTICS None

REPRODUCTIVE CHARACTERISTICS

- **Flowers**—White to pinkish ray flowers, numerous yellow disk flowers
- **Fruit**—Achenes, straw colored, flattened, one seeded

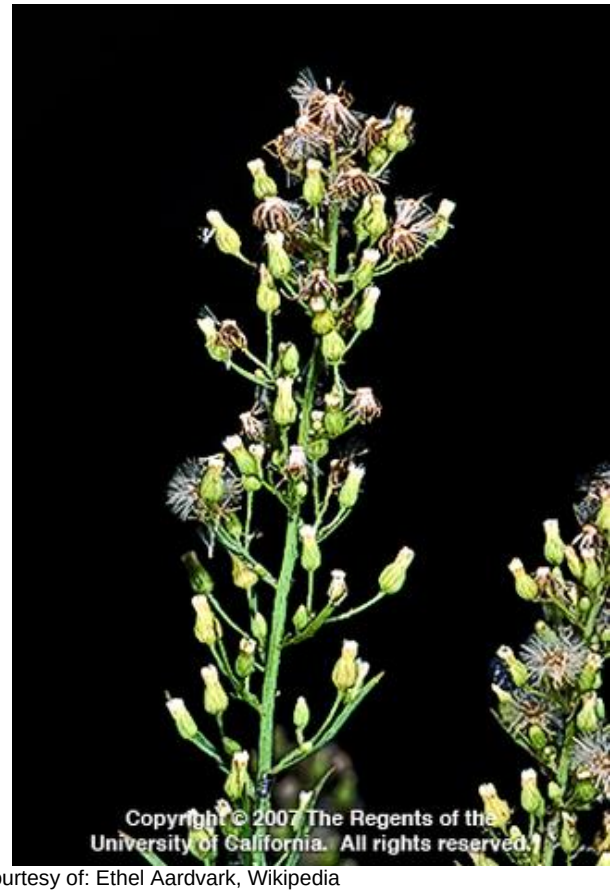
DISTRIBUTION Widely distributed in North America; grows in gardens, fields, and waste places and disturbed sites

VISUALS

SEEDLING

Courtesy of: weedscience.org

FLOWER



Courtesy of: Ethel Aardvark, Wikipedia

VISUALS (CONT.)

LEAVES

Courtesy of: weedscience.org

STEM

Courtesy of: University of Arkansas

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
	*Subject* Common Teasel

COMMON & SCIENTIFIC NAMES Common Teasel (*Dipsacus fullonum*)

SYNONYMS Barber's brush, brushes and combs, church broom, card teasel

PLANT HABITAT & LIFE HISTORY An erect biennial herb 6-foot-tall; introduced from Europe

VEGETATIVE CHARACTERISTICS

- **Seedling**—Composed of young leaves that are toothed edged and egg shaped with a puckered surface; persist over winter as a basal rosette
- **Roots**—Thick taproot and fibrous secondary roots
- **Stems**—Flowering, 2-8 feet tall, erect, angled, furrowed, branched near the top, prickly
- **Leaves**—Shiny green rosette leaves with scalloped edges and scattered stout hairs on the upper surface; attached to the stem by way of a leaf stalk (petiole)

SPECIAL IDENTIFYING CHARACTERISTICS Flowers form in cone-shaped, spiny clusters.

REPRODUCTIVE CHARACTERISTICS

- **Flowers**—2/5- to 3/5-inch individual flowers consisting of white petals united into a tube with 4 purple lobes
- **Fruit**—Light brown, about 1/5 inch long, ridged, hairy
- **Seed**—1 per fruit

DISTRIBUTION Northeastern U.S., the Pacific Coast, and southern Canada

VISUALS

SEED HEAD

Courtesy of: Steve Dewey. Utah State University. bugwood.org

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
	*Subject* Poison Hemlock

COMMON & SCIENTIFIC NAMES

Poison Hemlock (*Conium maculatum* L.)

SYNONYMS

None

PLANT HABITAT & LIFE HISTORY

Biennial; can grow to 3 meters tall; native to Europe and introduced in the Americas

VEGETATIVE CHARACTERISTICS

- **Seedling**—First emerges with two linear seed leaves, followed by first true leaves that are compound with 3 main divisions and often purple at the base
- **Roots**—Long white taproot with fibrous secondary roots
- **Seeds**—Pale brown; 1/12 to 1/8 inches long
- **Stems**—Erect, highly branched, distinctly ridged, smooth with purple blotches, hollow between nodes
- **Leaf**—Alternate, fern-like, divided into lobes of oblong to lanceolate leaflets

SPECIAL IDENTIFYING CHARACTERISTICS

Foliage has a strong, distinct parsnip odor.

REPRODUCTIVE CHARACTERISTICS

- **Flowers**—White, showy, petals notched (1-1.5 millimeters long) without calyx teeth
- **Fruit**—Schizocarp, grayish brown ovoid (2-4 millimeters long)

DISTRIBUTION

Widely distributed in North America; grows in ditches, pastures, roadsides, waste areas, marshy areas, and stream banks

VISUALS

SEEDS

Courtesy of: California Department of Food & Agriculture

PLANT

Provided by: Kentucky Transportation Cabinet

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
PESTICIDE MANUAL	*Subject* Kudzu

COMMON & SCIENTIFIC NAMES Kudzu [*Pueraria lobata* (Willd.) Ohwi.]

SYNONYMS None

PLANT HABITAT & LIFE HISTORY Perennial, trailing or climbing vine, up to 30 meters in length; introduced from Japan, native to Japan and China

VEGETATIVE CHARACTERISTICS

- **Seedling**—Vine-like; young stems covered with long, fine hairs
- **Roots**—Mealy, tuberous
- **Stems**—Usually herbaceous but may become woody, high climbing and twining, young stems pubescent, up to 2.5 centimeters thick
- **Leaves**—Alternate, pinnately 3-foliate, long petioles (may be as long as rest of leaf), leaflets broadly ovate in outline, may be entire or 2–3-lobed, 5–12 centimeters long, hairy beneath, stipules ovate to lance-shaped, 8–12 millimeters long

SPECIAL IDENTIFYING CHARACTERISTICS Most infestations found on roadsides or in erodible areas.

REPRODUCTIVE CHARACTERISTICS

- **Flowers**—Showy, borne in axillary racemes up to 20 centimeters long; standard (largest petal) violet-purple to reddish-purple with yellow spot at base
- **Fruit**—Legume, linear-oblong, 4–5 centimeters long, somewhat flattened, reddish-brown, covered with long, fine hairs
- **Seed**—Round to oval in outline, somewhat compressed

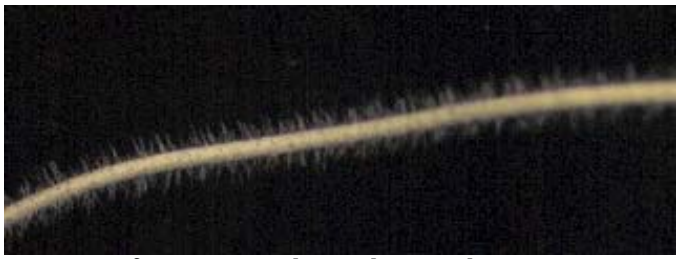
DISTRIBUTION Covers all southeastern U.S., north into Maryland and west to east Texas

VISUALS

SEEDLING

Courtesy of: Virginia Tech Weed ID Guide

STEM



Courtesy of: Virginia Tech Weed ID Guide

VISUALS (CONT.)

LEAVES

Courtesy of: Virginia Tech Weed ID Guide

FIELD VIEW

Courtesy of: Virginia Tech Weed ID Guide

VISUALS (CONT.)

SEEDPOD

Courtesy of: Virginia Tech Weed ID Guide

FLOWER

Courtesy of: Peggy Greb, Wikipedia

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
	*Subject* Multiflora Rose

COMMON & SCIENTIFIC NAMES Multiflora Rose (*Rosa multiflora*)

SYNONYMS None

PLANT HABITAT & LIFE HISTORY Thorny, perennial shrub growing 10–15 feet in height and 9–13 feet in width; introduced for ornamental purposes from eastern Asia (Japan, Korea, and eastern China)

VEGETATIVE CHARACTERISTICS

- **Roots**—Roots are wide-ranging and capable of resprouting. In addition, stem tips that contact the soil surface are capable of rooting, through a process known as layering, to form new plants.
- **Stems**—Wide, arching canes covered with hard thorns
- **Leaves**—Alternate, pinnately compound, and have 5–11 sharply toothed oval leaflets. Divided in 5–11 sharply toothed leaflets; base of each leaf stalk bears a pair of small fringed structures (stipules).

SPECIAL IDENTIFYING CHARACTERISTICS Combination of upright arching stems and fringed stipules. Grows aggressively and produces large numbers of fruits (hips) that are eaten and dispersed by a variety of birds. A thorny, bushy shrub can form impenetrable thickets or "living fences" and smother out other vegetation.

REPRODUCTIVE CHARACTERISTICS

- **Flower**—Flowers are white, or slightly pinkish; individually they are ½–¾ inch wide. They appear in large, showy clusters at the ends of the branches in late May or early June.
- **Fruit**—Bright red, nearly round, and about 1/4 inch in diameter
- **Seed**—Angular achenes

DISTRIBUTION Throughout the eastern half of the United States and in Washington and Oregon

VISUALS

FLOWERS

Courtesy of: usmassgreeninfo.org

FLOWERS

Courtesy of: usmassgreeninfo.org

LEAVES

Courtesy of: usmassgreeninfo.org

VISUALS (CONT.)

FRUIT

Courtesy of: usmassgreeninfo.org

FIELD VIEW

Courtesy of: usmassgreeninfo.org

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
	*Subject* Amur Honeysuckle

COMMON & SCIENTIFIC NAMES Amur Honeysuckle (*Lonicera maackii*)

SYNONYMS Bush Honeysuckle

PLANT HABITAT & LIFE HISTORY Tardily deciduous, upright, arching branched shrub to small tree growing 30 feet in height introduced for ornamental purposes and wildlife from Asia

VEGETATIVE CHARACTERISTICS

- **Roots**—Shallow; wide-ranging and capable of resprouting; have stem tips that, when come in contact with the soil surface, are capable of rooting, through a process known as layering, to form new plants
- **Stems**—Opposite branched, light tan older branches hollow
- **Leaves**—Opposite in 2 rows; ovate to oblong with rounded bases; tapering to a long slender tip

SPECIAL IDENTIFYING CHARACTERISTICS Upright arching stems; grows aggressively and produces large numbers of fruits that are eaten and dispersed by a variety of birds

REPRODUCTIVE CHARACTERISTICS

- **Flower**—Axillary, bracted short stemmed clusters, each with white fragrant flowers in May or June
- **Fruit**—Abundant glossy red berries persistent into winter; 6-12 millimeters in diameter
- **Seed**—One seeded

DISTRIBUTION South Central and Eastern U.S.

VISUALS

FLOWERS

Courtesy of: usmassgreeninfo.org

FRUIT - FIELD VIEW

Courtesy of: usmassgreeninfo.org

DIVISION OF MAINTENANCE	*Chapter* NOXIOUS WEED IDENTIFICATION
	*Subject* Japanese Knotweed

COMMON & SCIENTIFIC NAMES Japanese Knotweed [*Polygonum cuspidatum*]

SYNONYMS Japanese Bamboo, fleeceflower

PLANT HABITAT & LIFE HISTORY Tall, perennial herbaceous shrub up to 3.0 meters tall; introduced as an ornamental from Asia

VEGETATIVE CHARACTERISTICS

- **Seedling**—Cotyledons club-shaped, 16 millimeters long and 8 millimeters wide; first leaves also club-shaped, coarse, serrate margin with spines on tops of serration
- **Roots**—Up to 65 foot long rhizomes
- **Stems**—Round, reddish brown about 2.5 centimeters in diameter resembling bamboo although not woody with hollow internodes and solid nodes

SPECIAL IDENTIFYING CHARACTERISTICS Large herbaceous shrub with all stems and foliage dying back in winter

REPRODUCTIVE CHARACTERISTICS

- **Flowers**—Terminal and axillary, branched sprays 8—15 centimeters long covered with tiny white to greenish flowers.
- **Seed**—Dangling, winged fruit contain 1 triangular shiny nutlet

DISTRIBUTION Eastern United States

VISUALS

LEAVES

Courtesy of: Jack Ranney. University of Tennessee. bugwood.org

DIVISION OF MAINTENANCE

Chapter

EXHIBITS

Subject

Table of Exhibits

Roadside and Right-of-Way Application Chart. Find the Boom Buster Nozzle that is just right for your application needs.

Model	PSI	GPM	Range (feet)	Nozzle angle	Speed (mph) 5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
125-R 1/4" Pipe Thread	30	1.7	16	LEVEL	11	9	8	7	6	5																				
	40	2			13	11	9	8	7	6																				
120-5R 1/4" Pipe Thread	30	1.7	5	DOWN	34	28	24	21	19	17	15	14	13	12	11	11	10	9	9	8	8	8	7	7	7	6	6	6	6	6
	40	2			40	33	28	25	22	20	18	17	15	14	13	12	12	11	10	10	9	9	9	8	8	8	7	7	7	7
	50	2.2			44	36	31	27	24	22	20	18	17	16	15	14	13	12	11	11	10	10	9	9	9	8	8	8	8	7
140-R 1/4" Pipe Thread	30	2	17	LEVEL	12	10	9	8	7	6	5.5	5.0	4.6	4.3	4.0	3.8	3.5	3.3	3.2	3.0	2.9	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.1	2.0
	40	2.4			14	12	10	9	8	7	6.5	6.0	5.5	5.1	4.8	4.5	4.2	4.0	3.8	3.6	3.4	3.3	3.1	3.0	2.9	2.8	2.7	2.6	2.5	2.4
	50	2.7			16	14	12	10	9	8	7.4	6.8	6.2	5.8	5.4	5.1	4.8	4.5	4.3	4.1	3.9	3.7	3.5	3.4	3.2	3.1	3.0	2.9	2.8	2.7
180-6R 3/8" Pipe Thread	30	3.6	6	DOWN	59	50	42	37	33	30	27	25	23	21	20	19	17	17	16	15	14	14	13	12	12	11	11	11	10	10
	40	4.3			71	59	51	44	39	35	32	30	27	25	24	22	21	20	19	18	17	16	15	15	14	14	13	13	12	12
	50	4.8			79	66	57	50	44	40	36	33	30	28	26	25	23	22	21	20	19	18	17	17	16	15	15	14	14	13
180-10R 3/8" Pipe Thread	30	3.6	10	DOWN	36	30	25	22	20	18	16	15	14	13	12	11	10	10	9	9	8	8	8	7	7	7	7	6	6	6
	40	4.3			43	35	30	27	24	21	19	18	16	15	14	13	13	12	11	11	10	10	9	9	9	8	8	8	7	7
	50	4.8			48	40	34	30	26	24	22	20	18	17	16	15	14	13	13	12	11	11	10	10	10	9	9	8	8	8
187-R 3/8" Pipe Thread	30	3.6	19	LEVEL	19	16	14	12	11	10	9	8	7	6.9	6.4	6	5.7	5.4	5.1	4.8	4.6	4.4	4.2	4.0	3.9	3.7	3.6	3.4	3.3	3.2
	40	4.3			23	19	16	14	13	12	10	10	9	8.2	7.7	7	6.8	6.4	6.1	5.8	5.5	5.2	5.0	4.8	4.6	4.4	4.3	4.1	4.0	3.8
	50	4.8			26	21	18	16	14	13	12	11	10	9.2	8.6	8	7.6	7.1	6.8	6.4	6.1	5.8	5.6	5.4	5.1	4.9	4.8	4.6	4.4	4.3
260-5R 1/2" Pipe Thread	30	6.8	5	DOWN	135	112	96	84	75	67	61	56	52	48	45	42	40	37	35	34	32	31	29	28	27	26	25	24	23	22
	40	8			158	132	113	99	88	79	72	66	61	57	53	50	47	44	42	40	38	36	34	33	32	30	29	28	27	26
	50	8.8			174	145	124	109	97	87	79	73	67	62	58	54	51	48	46	44	41	40	38	36	35	34	32	31	30	29
260-11R 1/2" Pipe Thread	30	6.8	11	DOWN	61	51	44	38	34	31	28	26	24	22	20	19	18	17	16	15	15	14	13	13	12	12	11	11	11	10
	40	8			72	60	51	45	40	36	33	30	28	26	24	23	21	20	19	18	17	16	16	15	14	14	13	13	12	12
	50	8.8			79	66	57	50	44	40	36	33	30	28	26	25	23	22	21	20	19	18	17	17	16	15	15	14	14	13
265-R 1/2" Pipe Thread	30	6.8	20	LEVEL	35	29	25	22	19	17	16	14	13	12	11.5	11	10.2	9.6	9.1	8.6	8.2	7.8	7.5	7.2	6.9	6.6	6.4	6.2	6.0	5.8
	40	8			41	34	29	25	23	20	18	17	16	15	13.5	13	11.9	11.3	10.7	10.2	9.7	9.2	8.8	8.5	8.1	7.8	7.5	7.3	7.0	6.8
	50	8.8			45	37	32	28	25	22	20	19	17	16	14.9	14	13.1	12.4	11.8	11.2	10.6	10.2	9.7	9.3	8.9	8.6	8.3	8.0	7.7	7.4
370-R 3/4" Pipe Thread	30	14.4	10	DOWN	143	119	102	89	79	71	65	59	55	51	48	45	42	40	38	36	34	32	31	30	29	27	26	25	25	24
	40	16.7			165	138	118	103	92	83	75	69	64	59	55	52	49	46	44	41	39	38	36	34	33	32	31	30	29	28
	50	18.8			186	155	133	116	103	93	85	78	72	66	62	58	55	52	49	47	44	42	40	39	37	36	34	33	32	31
375-R 3/4" Pipe Thread	30	14.4	22	LEVEL	66	55	47	41	37	33	30	28	26	24	22	21	20	18	17	16.6	15.8	15.1	14.4	13.8	13.3	12.8	12.3	11.8	11.4	11.1
	40	16.7			77	64	55	48	43	38	35	32	30	27	26	24	23	21	20	19.2	18.3	17.5	16.7	16.0	15.4	14.8	14.2	13.7	13.3	12.8
	50	18.8			87	72	62	54	48	43	39	36	33	31	29	27	25	24	23	21.6	20.6	19.7	18.8	18.0	17.3	16.6	16.0	15.5	14.9	14.4
437-R 3/4" Pipe Thread	30	18.5	30	UP	62	52	44	39	34	31	28	26	24	22	21	19	18	17	16	15.5	14.8	14.1	13.5	12.9	12.4	11.9	11.5	11.1	10.7	10.3
	40	21.5			72	60	52	45	40	36	33	30	28	26	24	23	21	20	19	18.0	17.2	16.4	15.7	15.0	14.4	13.9	13.4	12.9	12.4	12.0
	50	24.2			81	68	58	51	45	41	37	34	31	29	27	25	24	23	21	20.3	19.3	18.5	17.7	16.9	16.2	15.6	15.0	14.5	14.0	13.5
500-R 1" Pipe Thread	30	29	20	LEVEL	144	120	103	90	80	72	65	60	55	51	48	45	42	40	38	36	34	33	31	30	29	28	27	26	25	24
	40	33			163	136	117	102	91	82	74	68	63	58	54	51	48	45	43	41	39	37	36	34	33	31	30	29	28	27
	50	37			183	153	131	114	102	92	83	76	70	65	61	57	54	51	48	46	44	42	40	38	37	35	34	33	32	31
504-R 1" Pipe Thread	30	29	40	UP	72	60	51	45	40	36	33	30	28	26	24	22	21	20	19	18	17	16	15.6	15.0	14.4	13.8	13.3	12.8	12.4	12.0
	40	33			82	68	58	51	45	41	37	34	31	29	27	26	24	23	21	20	19	19	17.8	17.0	16.3	15.7	15.1	14.6	14.1	13.6
	50	37			92	76	65	57	51	46	42	38	35	33	31	29	27	25	24	23	22	21	19.9	19.1	18.3	17.6	17.0	16.4	15.8	15.3

Gallons Per Acre (each nozzle)

less than 10 gallons per acre

10 to 25 gallons per acre

25 to 50 gallons per acre

50+ gallons per acre

PSI – Pounds Per Square Inch

GPM – Gallons Per Minute

Model 120-3 and 120-3R

1/4" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
3	3	DOWN	30	1.7	140	70	56	47	35	28	23	20	19
3	3	DOWN	40	2	165	83	66	55	41	33	28	24	22
3	3	DOWN	50	2.2	182	91	73	61	45	36	30	26	24

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/4" male Standard Pipe Thread and requires a 3/8" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/4" nozzles should have a 1/2" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 120-5 and 120-5R

1/4" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
5	5	DOWN	30	1.7	84	42	34	28	21	17	14	12	11
5	5	DOWN	40	2	99	50	40	33	25	20	17	14	13
5	5	DOWN	50	2.2	109	54	44	36	27	22	18	16	15

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/4" male Standard Pipe Thread and requires a 3/8" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/4" nozzles should have a 1/2" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 125 and 125-R

1/4" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)						
					1	2	3	4	5	6	7
17	15.5	LEVEL	30	1.7	54	27	18	13	11	9	7.8
17	15.5	LEVEL	40	2	64	32	21	16	13	11	9.1

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/4" male Standard Pipe Thread and requires a 3/8" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/4" nozzles should have a 1/2" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 140 and 140-R

1/4" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
18	16.5	LEVEL	30	2	30	15	12	10	7.5	6	5	4.3	4
18	16.5	LEVEL	40	2.4	36	18	14	12	9	7	6	5.1	4.8
18	16.5	LEVEL	50	2.7	41	20	16	14	10	8	6.8	5.8	5.4

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/4" male Standard Pipe Thread and requires a 3/8" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/4" nozzles should have a 1/2" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 180-6 and 180-6R

3/8" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
6	6	DOWN	30	3.6	149	74	59	50	37	30	25	21	20
6	6	DOWN	40	4.3	177	89	71	59	44	35	30	25	24
6	6	DOWN	50	4.8	198	99	79	66	50	40	33	28	26

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/4" male Standard Pipe Thread and requires a 3/8" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/4" nozzles should have a 1/2" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 180-10 and 180-10R

3/8" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
10	10	DOWN	30	3.6	89	45	36	30	22	18	15	13	12
10	10	DOWN	40	4.3	106	53	43	35	27	21	18	15	14
10	10	DOWN	50	4.8	119	59	48	40	30	24	20	17	16

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/4" male Standard Pipe Thread and requires a 3/8" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/4" nozzles should have a 1/2" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 187 and 187-R

3/8" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
20	18.5	LEVEL	30	3.6	48	24	19	16	12	9.6	8	6.9	6.4
20	18.5	LEVEL	40	4.3	58	29	23	19	14	12	9.6	8.2	7.7
20	18.5	LEVEL	50	4.8	64	32	26	21	16	13	11	9.2	8.6

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 3/8" male Standard Pipe Thread and requires a 1/2" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 3/8" nozzles should have a 3/4" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 260-5 and 260-5R

1/2" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
5	5	DOWN	30	6.8	337	168	135	112	84	67	56	48	45
5	5	DOWN	40	8	396	198	158	132	99	79	66	57	53
5	5	DOWN	50	8.8	436	218	174	145	109	87	73	62	58

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/4" male Standard Pipe Thread and requires a 3/8" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/4" nozzles should have a 1/2" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 260-11 and 260-11R

1/2" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
11	11	DOWN	30	6.8	153	77	61	51	38	31	26	22	20
11	11	DOWN	40	8	180	90	72	60	45	36	30	26	24
11	11	DOWN	50	8.8	198	99	79	66	50	40	33	28	26

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/4" male Standard Pipe Thread and requires a 3/8" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/4" nozzles should have a 1/2" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 265 and 265-R

1/2" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
21	19.5	LEVEL	30	6.8	86	43	35	26	22	17	14	12	11
21	19.5	LEVEL	40	8	102	51	41	34	25	20	17	14	13
21	19.5	LEVEL	50	8.8	112	56	45	37	28	22	19	16	15

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/2" male Standard Pipe Thread and requires a 3/4" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/2" nozzles should have a 1" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 370 and 370-R

3/4" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					4	6	8	10	14	16	20	24	30
10	10	DOWN	30	14.4	178	119	89	71	51	45	36	30	24
10	10	DOWN	40	16.7	207	138	103	83	59	52	41	34	28
10	10	DOWN	50	18.8	233	155	116	93	66	58	47	39	31

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1/4" male Standard Pipe Thread and requires a 3/8" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1/4" nozzles should have a 1/2" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 375 and 375-R

3/4" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
23	21.5	LEVEL	30	14.4	166	83	66	55	41	33	28	24	22
23	21.5	LEVEL	40	16.7	193	96	77	64	48	38	32	27	26
23	21.5	LEVEL	50	18.8	216	108	87	72	54	43	36	31	29

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 3/4" male Standard Pipe Thread and requires a 1" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 3/4" nozzles should have a 1 1/4" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 437 and 437-R

3/4" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)								
					2	4	5	6	8	10	12	14	15
31	29.5	UP	30	18.5	155	78	62	52	39	31	26	22	21
31	29.5	UP	40	21.5	180	90	72	60	45	36	30	26	24
31	29.5	UP	50	24.2	203	102	81	68	51	41	34	29	27

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 3/4" male Standard Pipe Thread and requires a 1" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 3/4" nozzles should have a 1 1/4" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 500 and 500-R

1" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)											
					4	6	8	10	12	14	16	18	20	24	26	30
21.5	20	LEVEL	30	29	179	120	90	72	60	51	45	40	36	30	28	24
21.5	20	LEVEL	40	33	204	136	102	82	68	58	51	45	41	24	31	27
21.5	20	LEVEL	50	37	229	153	114	91	76	65	57	51	46	38	35	30

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1" male Standard Pipe Thread and requires a 1 1/4" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1" nozzles should have a 1 ½" supply line.

Other Models Available:

Standard Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

Model 504 and 504-R

1" Standard Pipe Thread

Dist. (ft)	Effective Distance	Nozzle Angle	PSI	GPM	Speed (Miles Per Hour)											
					2	4	5	6	7	8	9	10	11	12	14	15
41	40	UP	30	29	179	90	72	60	51	45	40	36	33	30	26	24
41	40	UP	40	33	204	102	82	68	58	51	45	41	37	34	29	27
41	40	UP	50	37	229	114	92	76	65	57	51	46	42	38	33	31

- Shaded area shows **gallons per acre**. Water used for all calculations at a height of 4 ft above ground level. Calculations are for a single nozzle, please adjust numbers according to your setup. (For example: Two nozzles would require doubling the numbers in the table.)
- This nozzle fitting is 1" male Standard Pipe Thread and requires a 1 1/4" supply line.
- Two nozzles on the same supply line require a supply line two sizes larger than the nozzle size. (Two 1" nozzles should have a 1 ½" supply line.

Other Models Available:

Standard Band

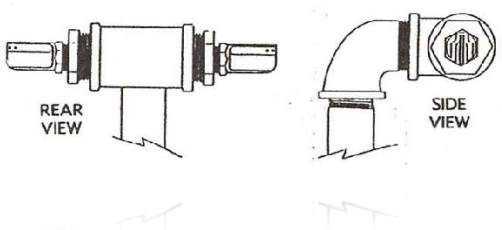
Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
125	¼"	30 – 40	17 ft	1 – 7 mph	1.7 - 2	7.8 – 64
140	¼"	30 – 50	18 ft	2 – 15 mph	2 – 2.7	4 – 41
187	3/8"	30 – 50	20 ft	2 – 15 mph	3.6 – 4.8	6.4 – 64
265	½"	30 – 50	21 ft	2 – 15 mph	6.8 – 8.8	11 – 112
375	¾"	30 – 50	23 ft	2 – 15 mph	14.4 – 18.8	22 -216
437	¾"	30 – 50	31 ft	2 – 15 mph	18.5 – 24.2	21 – 203
500	1"	30 – 50	21.5 ft	4 – 30 mph	29 – 37	24 – 229
504	1"	30 – 50	41 ft	2 – 15 mph	29 – 37	24 – 229

Narrow Band

Model	Thread Size	PSI range	Distance	Speed Range	GPM	Gallons / Acre
120-3	¼"	30 – 50	3 ft	2 – 15 mph	1.7 – 2.2	19 – 181
120-5	¼"	30 – 50	5 ft	2 – 15 mph	1.7 – 2.2	11 - 109
180-6	3/8"	30 – 50	6 ft	2 – 15 mph	3.6 – 4.8	20 – 198
180-10	3/8"	30 – 50	10 ft	2 – 15 mph	3.6 – 4.8	12 – 109
260-5	½"	30 – 50	5 ft	2 – 15 mph	6.8 – 8.8	45 – 435
260-11	½"	30 – 50	11 ft	2 – 15 mph	6.8 – 8.8	20 -198
370	¾"	30 – 50	10 ft	2 – 15 mph	14.4 – 18.8	24 – 233

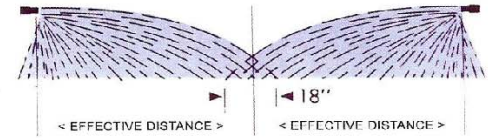
Nozzle Installation

1. Consult nozzle data sheet and be sure supply lines are adequate, especially if more than one nozzle is installed on the same supply line.
2. Angle nozzle to achieve desired distance as specified in chart.
3. In order to operate nozzles independently, install on separate supply lines with cut-off valves.
4. Nozzles should be mounted close enough together to ensure proper overlap behind spray vehicle.
5. Mounting nozzles on street elbows allows for quick and easy adjustment.



OPERATION

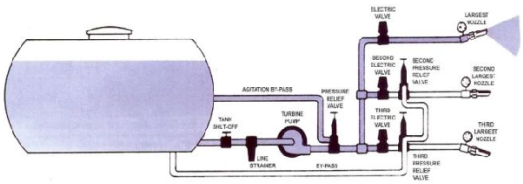
(1) In multiple pass spraying, the end of the pattern should overlap approximately 18".



(2) Use effective distance in feet for all calculations. See effective distance in feet in chart.
(3) Below is a typical two nozzle installation showing center overlap.

(4) Be sure to use enough water. University field tests have shown when applied with ground equipment, most chemicals work better with 25 or more gallons of water per acre.
(5) A coarse mesh inline strainer may be necessary if tank or water supply becomes contaminated with large particles.
(6) Small mesh nozzle strainers are not necessary due to the large orifice opening in these nozzles.
(7) In some applications, except for the small nozzles, these nozzles can be operated at speeds up to thirty miles per hour.
(8) With these nozzles, as with aerial and other methods of spraying, high and gusty wind can cause some pattern shifting. This can be minimized by spraying just above the crop or ground to be sprayed.

Sample sprayer setup



Always use good judgment when spraying. Don't spray in high winds. Always wear protective clothing and handle all chemicals with care.

Please contact your distributor for repair of damaged nozzles.

SPRAYER CALIBRATION SHEET

Sprayer/Truck No. _____ Size of Tank _____ Gallon

Nozzle Configuration: OC _____ Truck Speed _____ M.P.H.
Stack _____ G.P.M. _____ Gallon
Radiarc _____

To calculate total chemical load:

1. Tank Size

_____ gallons (No. of Acres per Load)

_____ = _____ Acres
GPA

2. (No. of Acres per Load) (Rate of Chem. per Acre) (Total Chem. per Load)

_____ Acres x _____ gal. or lbs. = _____gals. or lbs.

Chemical	Acres per Load	x	Rate per Acre	=	Total Chemical
_____	_____	x	_____	=	_____ gals. or lbs.
_____	_____	x	_____	=	_____ gals. or lbs.
_____	_____	x	_____	=	_____ gals. or lbs.

Surfactant _____/ Load
Drift Agent _____/ Load
Defoamer _____/ Load

SPRAYER CALIBRATION SHEET- Sample

Sprayer/Truck No. 7787-000 Size of Tank 1300 Gallon

Nozzle Configuration: OC ___ Truck Speed 8 M.P.H.
Stack yes G.P.M. 6.5 Gallon
Radiarc ___

To calculate total chemical load:

1. Tank Size

   13 gallons (No. of Acres per Load)

   25 = 52 Acres
   GPA

2. (No. of Acres per Load) (Rate of Chem. per Load) (Total Chem. per Load)

   52 Acres x 5 gal. or lbs. = 26 gals. or lbs.

Chemical	Acres per Load	x	Rate per Acre	=	Total Chemical
4-D	52	x	.5 gal.	=	26 gals. or lbs.
_____	_____	x	_____	=	_____ gals. or lbs.
_____	_____	x	_____	=	_____ gals. or lbs.

Surfactant 3.25 gal. / Load
Drift Agent 1 qt. / Load
Defoamer 1 qt. / Load

SPRAYER CALIBRATION AND PRODUCT NEED

Use: _____ Sprayer # / Truck #: _____

P.S.I. at Nozzle: _____ M.P.H.: _____

Swath: _____ G.P.M.: _____

G.P.A.: _____ Date: _____

Formula: Chemical / Tank = $\frac{\text{Chemical rate/ac. X tank vol.}}{\text{G.P.A.}}$

Chemical	___ac.	x	___gal.	=	_____/tank
	___ac.	x	___gal.	=	_____/tank
	___ac.	x	___gal.	=	_____/tank

Nozzels & Config.

Surfactant	_____/tank
Drift Agent	_____/tank
Defoamer	_____/tank

SPRAYER CALIBRATION AND PRODUCT NEED-Sample

Use: Guardrail

Sprayer # / Truck #: 250/6856

P.S.I. at Nozzle: 31

M.P.H.: 8

Swath: 5’

G.P.M.: 4.5

G.P.A.: 55

Date: 2/21/96

Formula: Chemical / Tank = Chemical rate/ac. X tank vol. / G.P.A.

Chemical						
	0.5 ac.	x	1000 gal.	=	9.10z	/tank
			55			
	1.33ac.	x	1000 gal.	=	24.2z	/tank
			55			
	ac.	x	gal.	=		/tank

Nozzels & Config.

p	p
p	p
p	p
p	p
p	p
.07	0.7
.07	0.7
.07	0.7
p	p
p	p
p	p

Surfactant	2 gal.	/tank
Drift Agent	3 gal.	/tank
Defoamer		/tank

BOOMLESS – SPRAYER * STACK NOZZLE * RADIARC NOZZLE

Instructions:

1. Fill tank ½ full of water.
2. Set pressure regulator to 30-35 PSI.
3. Spray and measure spray pattern width _____.
   (feet)
4. Collect spray output for all nozzles for ONE-minute _____. (128 oz. = 1 gal.)
   (gallons)
5. Select speed of travel _____.
   (MPH)

   To get MPH mark off 200 feet – drive length – time – in seconds – use following scale.

MPH	Time to Travel 200 feet (Seconds)
5	27
6	23
7	19
8	17
10	14
12	11

6. Gallons per acre output:

   GPM (Step #4) x 495 (factor)* = GPA (Gal. per Acre)

   MPH (Step #5) x Spray width (Step #3)

_____ x 495
GPM

_____ = _____

_____ x _____
MPH Spray Width

*Factor taken from the "DuPont Calibration Guide" for herbicide application.

Sample

BOOMLESS – SPRAYER * STACK NOZZLE * RADIARC NOZZLE

Instructions:

1. Fill tank ½ full of water.
2. Set pressure regulator to 30-35 PSI.
3. Spray and measure spray pattern width 16. (feet)
4. Collect spray output for all nozzles for ONE-minute 6.2. (128 oz. = 1 gal.) (gallons)
5. Select speed of travel 8. (MPH)

   To get MPH mark off 200 feet – drive length – time – in seconds – use following scale.

MPH	Time to Travel 200 feet (Seconds)
9	27
10	23
11	19
12	17
10	14
12	11

6. Gallons per acre output:

   GPM (Step #4) x 495 (factor)* = GPA (Gal. per Acre)

   MPH (Step #5) x Spray width (Step #3)

62 x 495
GPM

3069 = 23.9

8 x 16
MPH Spray Width

*Factor taken from the "DuPont Calibration Guide" for herbicide application.

HANDGUN CALIBRATION

1. Mark off an area 31.5 feet x 31.5 feet. (This is 0.023A or 1,000 SF)

2. Record time to treat this area _____ uniformly.
(Seconds)

3. Collect spray (clean water) to equal seconds to treat marked off area _____.
(Gallons)

4. Amount of water to treat one acre:

   a. 1 acre = Area Factor 43,560 – 43.56
   Area marked off 1,000

   b. Area Factor x gallon from No. 3 = Gallons per Acre

   Example:

43.56	x	2.3 gal.	=	100 gallons per acre
43.56	x	1.15 gal.	=	50 gallons per acre
43.56	x	0.57 gal.	=	25 gallons per acre

   Your Test Plot:

43.56	x	____ gal.	=	__ gallons per acre
43.56	x	____ gal.	=	__ gallons per acre

HANDGUN CALIBRATION – Sample

1. Mark off an area 31.5 feet x 31.5 feet. (This is 0.023A or 1,000 SF)

2. Record time to treat this area 180 (Seconds) uniformly.

3. Collect spray (clean water) to equal seconds to treat marked off area 1.15. (Gallons)

4. Amount of water to treat one acre:

   c. 1 acre = Area Factor 43,560 – 43.56
   Area marked off 1,000

   d. Area Factor x gallon from No. 3 = Gallons per Acre

Example:

43.56	x	2.3 gal.	=	100 gallons per acre
43.56	x	1.15 gal.	=	50 gallons per acre
43.56	x	0.57 gal.	=	25 gallons per acre

Your Test Plot:

43.56	x	1.15 gal.	=	50 gallons per acre
43.56	x	____ gal.	=	__ gallons per acre

COMMON CONVERSIONS

Acres x 43,560 = square feet
Acres x 4,480 = square yards

Bushels x 2,150.42 = cubic inches
Bushel = 1.24 cubic feet
Bushel = approximately 1/20 cubic yard
Bushels x 4 = pecks
Bushels x 64 = pints
Bushels x 32 = quarts
Bushel = 35.24 liters

Centimeters x 0.3937 = inches
Centimeters x 0.01 = meters
Centimeters x 10 = milliliters

Cubic feet x 1,728 = cubic inches
Cubic feet x 0.03704 = cubic yards
Cubic feet x 7.4805 = gallons
Cubic feet x 59.84 = pints (liquid)
Cubic feet x 29.92 = quarts (liquid)
Cubic foot = 25.71 quarts (dry)
Cubic foot = 0.804 bushels
Cubic foot = 28.32 liters

Cubic inches x 16.39 = cubic centimeters

Cubic meters x 1,000,000 = cubic centimeters
Cubic meters x 35.31 = cubic feet
Cubic meters x 61,023 = cubic inches
Cubic meters x 1.308 = cubic yards
Cubic meters x 264.2 = gallons
Cubic meters x 2,113 = pints (liquid)
Cubic meters x 1,057 = quarts (liquid)

Cubic yards x 27 = cubic feet
Cubic yards x 46,656 = cubic inches
Cubic yards x 0.7646 = cubic meters
Cubic yards x 202 = gallons
Cubic yards x 1,616 = pints (liquid)
Cubic yards x 807.9 = quarts (liquid)
Cubic yard = 21.71 bushels

1 Cup = 8 fluid ounces
1 Cup = 0.5 pints
1 Cup = 236.5 milliliters
1 Cup = 0.25 quarts
1 Cup = 16 tablespoons
1 Cup = 48 teaspoons

Feet x 30.48 = centimeters
Feet x 12 = inches
Feet x 0.3048 = meters
Feet x 1/3 or 0.33333 = yards

Miles x 5,280 = feet
Miles x 320 = rods
Miles x 1,760 = yards

Miles per hour x 88 = feet per minute
Miles per hour x 1,467 = feet per second

Ounces (dry) x 437.5 = grains
Ounces (dry) x 28.3495 = grains
Ounces (dry) x 0.0625 = pounds

Ounces (liquid) x 1.805 = cubic inches
Ounces (liquid) x 0.0078125 = gallons
Ounces (liquid) x 29.573 = millimeters (cubic centimeters)
Ounces (liquid) x 0.03125 = quarts (liquid)

PPM x 0.0584 = grains per US gallon

PPM x 0.001 = grams per liter
PPM x 8.345 = pounds per million gallons

Pecks x 0.25 = bushels
Pecks x 537.605 = cubic inches
Pecks x 16 = pints (dry)
Pecks x 8 = quarts (dry)

Pints (dry) x 0.015625 = bushels
Pints (dry) x 33.6003 = cubic inches
Pints (dry) x 0.0625 = pecks
Pints (dry) x 0.5 = quarts (dry)

Pints (liquid) x 28.875 = cubic inches
Pints (liquid) x 0.125 = gallons
Pints (liquid) x 16 = ounces (liquid)
Pints (liquid) x 0.5 = quarts (liquid)
Pints (liquid) x 0.4732 = liters
1 Pint = 2 cups
1 Pint = 472 milliliters
1 Pint = 32 tablespoons

Pounds x 7,000 = grains
Pounds x 453.5924 = grams
Pounds x 16 = ounces
Pounds x 0.0005 = tons

Pounds of water x 0.01602 = cubic feet
Pounds of water x 27.68 = cubic inches
Pounds of water x 0.1198 = gallons

Quarts (dry) x 0.03125 = bushels
Quarts (dry) x 67.20 = cubic inches
Quarts (dry) x 0.125 = pecks
Quarts (dry) x 2 = pints (dry)

COMMON CONVERSIONS

Feet per minute x 0.01667 = feet per second
Feet per minute x 0.01136 = miles per hour

1 Fluid ounce = 2 tablespoons
1 Fluid ounce = 6 teaspoons
1 Fluid ounce 29.6 milliliters
1 Fluid ounce = 1.805 cubic inches

Gallons x 3,785 = cubic centimeters
Gallons x 0.1337 = cubic feet
Gallons x 231 = cubic inches (liquid)
Gallons x 269 = cubic inches (dry)
Gallons x 128 = ounces (liquid)
Gallons x 8 = pints (liquid)
Gallons x 4 = quarts (liquid)
Gallon = 0.83 British gallons

Gallons of water x 8.3453 = pounds of water

Grains x 0.0648 = grams

Grams x 15.43 = grains
Grams x 0.001 = kilograms
Grams x 1,000 = milligrams
Grams x 0.0353 = ounces

Inches x 2.54 = centimeters
Inches x 0.08333 = feet
Inches x 0.02778 = yards

Kilograms x 1,000 = grams
Kilograms x 2.205 = pounds

Kilometers x 3,281 = feet
Kilometers x 1,000 = meters
Kilometers x 0.6124 = miles
Kilometers x 1,094 = yards

Liters x 1,000 = cubic centimeters
Liters x 0.0353 = cubic feet
Liters x 61.02 = cubic inches
Liters x 0.001 = cubic meters
Liters x 0.2642 = gallons
Liters x 2.113 = pints (liquid)
Liters x 1.057 = quarts (liquid)

Meters x 100 = centimeters
Meters x 3.281 = feet
Meters x 39.37 = inches
Meters x 0.001 = kilometers
Meters x 1,000 = millimeters
Meters x 1,094 = yards

Quarts (liquid) x 57.75 = cubic inches
Quarts (liquid) x 0.25 = gallons
Quarts (liquid) x 0.9463 = liters
Quarts (liquid) x 32 = ounces (liquid)
Quarts (liquid) x 2 = pints (liquid)

Rods x 16.5 = feet

Square feet x 144 = square inches
Square feet x 0.11111 = square yards

Square inches x 0.00694 = square feet

Square miles x 640 = acres
Square miles x 28,878,400 = square feet
Square miles x 3,097,600 = square yards

Square yards x 0.0002066 = acres
Square yards x 9 = square feet
Square yards x 1,296 = square inches

Temperature (C) + 17.98 x 1.8 = temp. F
Temperature (F) - 32 x 5/9 or 0.5555 = temp. C

1 Tablespoon = 3 teaspoons
1 Tablespoon = 15 milliliters
1 Tablespoon = 0.5 fluid ounces

1 Teaspoon = 5 milliliters
1 Teaspoon = 0.17 fluid ounces
1 Teaspoon = 60 drops

Ton x 907.1849 = kilograms
Ton x 32,000 = ounces
Ton x 2,000 = pounds

Yards x 3 = feet
Yards x 36 = inches
Yards x 0.9144 = meters
Yards x 0.000568 = miles

Test Plot Conversion Table

1 kilogram = 1,000 grams = 2.2 pounds
1 gram = 1,000 milligrams = 0.35 ounces
1 liter = 1,000 milliters or cubic centimeters
1 milliliter or cubic centimeter = 0.34 fluid ounces
1 milliliter or cubic centimeter (water) weighs 1 gram
1 liter (water) weighs 1 kilogram
1 pound = 453.6 grams
1 ounce = 28.35 grams
1 pint (water) weighs approximately 1 pound
1 gallon (water) weighs approximately 8.34 pounds
1 gallon = 4 quarts = 3.785 liters
1 quart = 2 pints = 0.946 liters

FLUID OUNCES CONVERSION TABLE

NOTE: Fluid ounces are not equal to dry weight ounces

1/8 PINT =	2 FLUID OUNCES
1/4 PINT =	4 FLUID OUNCES
1/3 PINT =	5.33 FLUID OUNCES
1/2 PINT =	8 FLUID OUNCES
2/3 PINT =	10.67 FLUID OUNCES
3/4 PINT =	12 FLUID OUNCES
1 PINT =	16 FLUID OUNCES
1 1/2 PINTS =	24 FLUID OUNCES
2 PINTS/ 1 QUART =	32 FLUID OUNCES
2 1/2 PINTS =	40 FLUID OUNCES
3 PINTS =	48 FLUID OUNCES
4 PINTS/ 2 QUARTS =	64 FLUID OUNCES
5 PINTS =	80 FLUID OUNCES
6 PINTS/ 3 QUARTS =	96 FLUID OUNCES
7 PINTS =	108 FLUID OUNCES
8 PINTS/ 4 QUARTS/ 1 GALLON =	128 FLUID OUNCES
1 LITER =	33.8 FLUID OUNCES

LIQUID MEASURE-WEIGHT TABLE (WATER)

1	PINT WATER	@	60 F	16	FLUID OUNCES =	1.042 POUNDS
1	QUART WATER	@	60 F	32	FLUID OUNCES =	2.084 POUNDS
1	GALLON WATER	@	60 F	128	FLUID OUNCES =	8.337 POUNDS

DIPSTICK GAUGE CONVERSION TABLE
(for 55-Gallon Drums*)

NOTE: You will need a 3-foot, flat stick. A length of 1 x 2, or an old yardstick. Mark the correct gallonage figure directly on the stick for each inch. Half inches can be estimated. Use the appropriate listing below, depending on whether your drum is mounted vertically or sideways.

HORIZONTAL DRUM			UPRIGHT DRUM
Inches	Gallons		Inches
22	55		33
21	54		32.5
20.25	53		31.75
19.75	52		31.25
19.25	51		30.5
18.75	50		30
18.25	49		29.5
17.75	48		28.75
17.5	47		28.25
17	46		27.5
16.75	45		27
16.5	44		26.5
16	43		25.75
15.75	42		25.25
15.25	41		24.5
15	40		24
14.75	39		23.5
14.25	38		22.75
14	37		25.25
13.75	36		21.5
13.25	35		21
13	34		20.5
12.75	33		19.75
12.25	32		19.25
12	31		18.5
11.75	30		18
15	29		17.5
11.125	28		16.75

HORIZONTAL (con't)			UPRIGHT (con't)
Inches	Gallons		Inches
10.875	27		16.25
10.5	26		15.5
10.25	25		15
10	24		14.5
9.75	23		13.75
9.25	22		13.25
9	21		12.5
8.75	20		12
8.25	19		11.5
8	18		10.75
7.75	17		10.25
7.25	16		9.5
7	15		9
6.75	14		8.5
6.25	13		7.75
6	12		7.25
5.75	11		6.5
5.5	10		6
5	9		5.5
4.5	8		4.75
4	7		4.25
3.75	6		3.5
3.25	5		3
3	4		2.5
2.5	3		1.75
1.75	2		1.25
1.25	1		0.5
0	0		0

*Most drums are 22 inches in diameter, 33 inches tall and weigh 500 pounds when full.

KENTUCKY TRANSPORTATION CABINET
Department of Highways
DIVISION OF MAINTENANCE

TC 71-14
Rev. 03/2009
Page 1 of 1

CONSENT & RELEASE

SECTION 1: LOCATION INFORMATION

COUNTY	ROUTE #	MILE POINT		
ROAD NAME	**ADDRESS**	**CITY**	**STATE**	**ZIP**

SECTION: AGREEMENT

WHEREAS, the Transportation Cabinet, Commonwealth of Kentucky, in order to protect Highway No. _____ finds it necessary to do the following work:

The work will be done on the land of:

NOW, THEREFORE, in consideration of the above and the incidental benefits accruing to the property, I hereby consent and agree that the Transportation Cabinet may come upon the above property and do the work as set out above, and do further agree that I will assert no claim for damages against the Transportation Cabinet by reason of said work, but by these presents shall be forever barred.

DATE

_____

PROPERTY OWNER

_____

PROPERTY OWNER

_____

WITNESS *(county superintendent/designated representative)*

_____

APPROVED *(chief district engineer)*

_____

Common Name	Trade Name	Manufacturer
2,4-D	Formula 40	Nu-Farm
2,4-D Dry	IVM Solution	Nu-Farm
Acclaim Extra	Acclaim Extra	Bayer
BK 800	BK 800	PBI Gordon
Element 3A	Element 3A	Dow
Element 4	Element 4	Dow
Escort XP	Escort XP	Bayer
Esplanade 200SC	Esplanade 200SC	Bayer
Fusilade II	Fusilade II	Syngenta
Krenite S	Krenite S	Bayer
Milestone VM	Milestone VM	Dow
MSMA	Bueno 6+	Drexel
Opensight	Opensight	Dow
Oust Extra	Oust Extra	Bayer
Outrider	Outrider	Monsanto
Overdrive	Overdrive	BASF
Payload	Payload	Valent
Pendulum Aquacap	Pendulum Aquacap	BASF
Perspective	Perspective	Bayer
Plateau	Plateau	BASF
Polaris AC Complete	Polaris AC Complete	Nu-Farm
Proclipse	Proclipse	Nu-Farm
Rodeo	Rodeo	Dow
Roundup Custom	Roundup Custom	Monsanto
Streamline	Streamline	Bayer
Stronghold	Stronghold	PBI Gordon
Telar	Telar	Bayer
Transline	Transline	Dow
Viewpoint	Viewpoint	Bayer

BASF CORPORATION 100 Campus Drive Florham Park, New Jersey 07932 800-669-2273 **Overdrive, Plateau, Pendulum**	DREXEL CHEMICAL CO. 1700 Channel Avenue Memphis, TN 38113 901-774-4370 **Bueno 6+**	PBI GORDON CORPORATION 1217 West 12th Street Kansas City, MO 64101 816-421-4070 **BK 800, Stronghold**
BAYER CROP SCIENCE 2 T.W. Alexander Drive R. T. Park, NC 27709 **Acclaim Extra, Escort, Esplanade, Krenite, Oust, Perspective, Streamline, Telar, Viewpoint**	MONSANTO AG. PRODUCTS 800 North Lineburg Blvd. St. Louis, MO 64101 314-694-1000 **Outrider, Roundup Custom**	SYNGENTA CROP PROTECT. P.O. Box 18300 Greensboro, NC 27419 866-796-4368 **Fusilade II**
DOW AGROSCIENCES 9330 Zionsville Rd. Indianapolis, IN 46268 317-337-3000 **Element 3A, Element 4, Milestone VM, Opensight, Transline,**	NUFARM AMERICAS, INC 150 Harvester Drive, Suite 200 Burr Ridge, IL 60527 800-345-3330 **IVM Solution, Formula 40, Polaris AC Complete, Proclipse**	VALENT USA CORP. P.O. Box 8025 Walnut Creek, CA 94596 800-682-5368 **Payload**

DECONTAMINATION OF SPRAY TANKS

Purpose: To remove traces of pesticides* from sprayer tanks.

The following steps are suggested for thorough cleaning.

1. Hose down the inside of the tank, filling it with 50-100 gallons of water.

2. Flush the rinsate on target area as defined on pesticide label.

3. Refill tank with 50-100 gallons of water and clean with one of the following:

    a. 1 pound of detergent per 50 gallons of water.
    b. ½ gallon of household ammonia per 50 gallons of water (let stand in tank overnight).
    c. 2 ½ pounds of sal soda per 50 gallons of water.
    d. 2 pounds activated charcoal per 50 gallons (leave in tank and lines for 10 minutes).

4. Spray rinsate on target area as defined by label.

*This applies only to general use pesticides.

DRIFT MANAGEMENT

What is Drift?

Drift is the movement of a pesticide through air, during or after application, to a site other than the intended site of application. In most cases, this movement is limited to the edges of the field or fencerow. However, under certain conditions, off-target movement may affect areas at greater distances from the field. Problems occur when this movement affects a sensitive crop or another person's property.

Two Types of Drift

Drift is often associated with the physical movement of spray droplets away from the target site at the time of application. This type of drift, usually called **airborne drift**, results from factors associated with application methods and equipment. Airborne drift may be simply a spray swath displacement that results in targeted deposition of the spray droplet at a distance not more than 30 feet from the point of spray release. Small spray droplets, however, may travel several thousand feet before depositing into a non-target area. Smaller airborne droplets may evaporate in the atmosphere and travel for great distances. The resulting vaporized droplets usually do not create significant problems because they are dispersed over large areas. Drift sometimes occurs even days after the application is made. This type of drift, usually called **vapor drift**, is most commonly associated with volatilization (changing from a liquid to a gas) of pesticides with subsequent movement from the target area. The vapor drift becomes a significant concern only if the pesticide applied is highly volatile and the atmospheric conditions become suitable for rapid vaporization of the pesticide.

Factors Affecting Drift

Drift is influenced by many factors that usually may be grouped into one of the following four categories:

1. Spray characteristics
2. Equipment and application techniques used
3. Weather
4. Operator care and skill

Droplet Size

Spray droplet size is by far the most important factor affecting drift. Spray droplet diameters are measured in micrometers. A micrometer is 1/25,000 of an inch and is usually referred to as a *micron*. For reference, the thickness of a human hair or a sheet of paper is roughly 75 microns.

Research shows there is a

Recommended Procedures for Reducing Drift Damage from Ground Application of Pesticides

Procedure	Example	Explanation
Select a nozzle type that produces coarse droplets.	Use Raindrop, wide-angle full-cone or flooding nozzles.	Use the largest droplets possible while providing necessary coverage.
Use the lower end of the nozzle's pressure range.	Use 20 to 40 psi for Raindrop and less than 25 psi for other nozzle types.	Higher pressures generate many more small droplets (less than 100 microns).
Lower boom height.	Use the lowest boom height possible while maintaining uniform distribution. Use drops for systemic herbicides in corn.	Wind speed increases with height. Lowering boom height by a few inches can reduce off-target drift.
Increase nozzle size.	If normal gallonage is 15 to 20 gpa, increase to 25 to 30 gpa.	Larger capacity nozzles will reduce spray deposited off-target.
Spray when wind speeds are less than 10 mph and when wind direction is away from sensitive plants.	Leave a buffer zone if sensitive plants are downwind. Spray buffer zone when the wind changes.	More of the volume will move off-target as wind increases.
Do not spray when the air is completely calm	Absolutely calm air generally occurs in early morning or late evening.	Absolutely calm air reduces mixing, and leaves a spray cloud that may move downwind at a later time.
Use a drift control additive when needed.	Several long-chain-polymer products are available.	Drift control additives increase the average droplet size produced by nozzles.

Source: Loren E. Bode and R.E. Wolf, Agricultural Engineering Dept., University of Illinois.

rapid decrease in the drift potential of droplets greater than about 150 or 200 microns.

Droplet size where drift potential becomes insignificant depends on wind speeds, but lies in the range of 150 to 200 microns for wind speeds of 1 to 9 miles per hour.

Spray particles under 50 microns in diameter remain suspended in the air indefinitely or until they evaporate. They should be avoided because there is no way to control deposition of these small droplets. For instance, there is no need to use small droplets when applying soil-incorporated or systemic herbicides. However, small droplets are desirable when applying insecticides and fungicides because they provide better penetration into the canopy and better coverage. Good coverage is essential with insecticides and fungicides because of the small size of the target organism.

Air-blast sprayers, which are commonly used to apply insecticides and fungicides in orchards, produce a relatively high number of small droplets.

However, some of the droplets never reach their target because they are directed upward where there is no canopy. An option to decrease drift with these sprayers is to install a baffled extension manifold that directs the spray toward the tree canopy.

Most pesticide applications should attain a balance between drift reduction provided by large droplets and good coverage provided by small droplets. Recommended droplet sizes for application of fungicides, insecticides and herbicides are 150-250, 200-300 and 250-400 microns, respectively.

Nozzle Type and Size

Most current agricultural sprayers use hydraulic nozzles to meter and atomize the liquid into drops. Hydraulic nozzles produce a wide spectrum of droplet sizes ranging from under 10 to over 1,000 microns.

Drift can be minimized with nozzles that produce relatively large droplets, but still give sufficient penetration and coverage of the target.

For example, flood-fan and wide-angle full-cone nozzles produce much fewer drift-prone droplets than hollow-cone nozzles and flat-fan nozzles. However, flood-fan and full-cone nozzles do not provide adequate control when applying contact herbicides, insecticides and fungicides. Fortunately, nozzle manufacturers have developed "extended- range" flat-fan nozzles and new cone nozzles that are capable of producing relatively large droplets with adequate spray coverage.

Nozzle Orientation

Orientation of nozzles is not critical for ground applications, but plays an important role in reducing drift from aircraft applications. When a nozzle is pointed backward toward the tail of the aircraft, larger droplets are produced. The same nozzle produces medium droplets when pointed downward and smaller droplets when pointed into the air stream.

Spray Height

Small spray droplets have low inertial energy, making them highly susceptible to drift. In addition, wind velocity is usually greater as height above the ground increases. Therefore, the closer the nozzle tips are to the ground, the smaller the likelihood of spray pesticide drift.

Spray Pressure

Spray pressure exerted on hydraulic nozzles provides the energy that breaks a stream of water into droplets, and thus is a key factor in regulating spray droplet size. Increased pressure generally causes a decrease in droplet size. Reducing pressure will reduce drift because larger droplets are formed, but operating nozzles below the recommended pressure will also reduce effective coverage and may result in poor distribution and improper spray overlap.

Chemical Formulation

A courser spray can be achieved by increasing the viscosity of the spray mix. Increased viscosity results in an upward shift of the droplet spectrum so that there are fewer of the fine drops that are subject to drift. Many spray additives can be added to a tank mix to increase its viscosity.

Some pesticide formulations are more volatile than others. Therefore, use formulations with low volatility to reduce vapor drift.

Evaporation

With water carriers, spray droplets become smaller as they fall because of evaporation. For typical applications with ground applicators, droplets of 50 microns and less will completely evaporate to a residual core of pesticide before reaching the target. Droplets greater than 200 microns will

have no significant reduction in size before deposition on the target.

Weather Factors

Weather can critically influence the off-target movement of pesticides. Several factors associated with the microclimate at the application site can contribute to drift. These factors include wind velocity and direction, relative humidity and temperature, and atmospheric stability and inversions. The impact that various weather factors have on drift can be related to the volume of droplets 150 microns or less in diameter. If these small droplets are eliminated, weather's effect on drift is reduced considerably. Here is a brief discussion on how weather-related factors influence drift and how you can minimize their effects:

Wind Velocity and Direction

Factors such as droplet size and downward velocity, air turbulence and spray boom height affect the distance a droplet travels before depositing on an object. The greater the wind speed, the farther off-target a droplet of a given size will be carried. The larger the droplet, the less it is affected by the wind and the faster it falls. Wind direction is as important as wind velocity in reducing the damage caused by drift. The presence of sensitive vegetation near the spray site, particularly downwind, is one of the first things that should be evaluated, but is often overlooked when beginning a spray application.

Humidity and Temperature

Relative humidity and temperature go hand-in-hand in affecting spray drift. While they generally are not as critical as wind velocity, they are a strong influence in some geographic regions or under certain meteorological conditions. As a particle falls through the air, surface molecules of water evaporate into the atmosphere. This evaporation reduces the size and mass of the particle, enabling it to remain airborne longer and, under the right conditions, to drift farther from the application site. While evaporative loss of spray materials occurs under almost all atmospheric conditions, these losses are less pronounced under the environmental conditions that occur in the cooler parts of the day - early morning and late afternoon. The relative humidity is usually highest during these cool periods.

Atmospheric Stability

Atmospheric stability is an important factor influencing drift. Under normal meteorological conditions, the air temperature decreases by 5.4°F per 1,000 feet of height. Cool air tends to sink, displacing lower warm air and causing vertical mixing. As a warm air layer rises, suspended droplets rise with it and dissipate into the upper layers by normal air turbulence and vertical mixing. However, problems may arise when the atmosphere is very stable. Under stable conditions, a warm air layer at some distance overhead may become a blanket, holding down cooler air underneath. This phenomenon is usually referred to as *atmospheric inversion*. Particles suspended in the cool layer cannot move anywhere except laterally, possibly for several miles. Eventually, the suspended cloud may encounter a downdraft, forcing it back to earth and depositing it of-target - possibly over a sensitive crop.

Again, the best way to avoid drift associated with atmospheric inversions is to eliminate the formation of small particles (150 microns or smaller) from the spray effluent.

Operator Skill and Care

Under a given spray situation, any one of the previous eight factors may be the most critical in reducing drift hazards. Ultimately, the applicator determines this critical factor and takes precautions against it.

Equipment Modifications

Spray droplets from conventional sprayers deposit mainly on to upper sides of horizontal surfaces due to gravity, or on vertical surfaces by their velocity and movement in air currents around the target. Scientists and equipment companies have been exploring the possible use of other forces to increase application efficiency while reducing spray drift. Some new developments for increasing deposition efficiency of especially small droplets include partially or completely covered booms, air-assisted spraying and electrostatic spraying.

Shielded Sprayer Boom

Partially covering a sprayer boom with a shield has been shown helpful in reducing spray

drift. Results from laboratory tests conducted at the University of Missouri indicated that a mechanical shield could reduce spray drift deposit by up to 70 percent.

Tests conducted in Ohio under field conditions generally showed reduction in drift deposits of up to 65 percent with the shield.

Covered (Shrouded) Boom

Covering the boom completely with a shroud has been shown to reduce drift. Some companies have developed simple shrouds, while others have improved the aerodynamics of airflow around the shield by placing an airfoil over the shield.

Another advantage of a covered shield is that pesticides can be applied using small droplets that provide better coverage, and the volume of carrier needed can be reduced significantly.

Air-Assisted Spraying

Several studies have shown that air assistance reduces drift deposits from boom sprayers. The general concept with air-assisted spraying is to use air to replace part or all of the water as a pesticide carrier. Some air-assist systems simply atomize the spray solution, while others use high-velocity airflow to transport the spray mixture to the target. This enables the applicator to use small droplets without increasing the risk of drift. At least one company manufactures a sprayer that uses a stream of air to direct the spray to the target by entraining droplets in a downward-moving air curtain.

Electrostatic Spraying

Electrostatic charging of small droplets has been considered as a possible way to increase the deposition of small droplets. An electrical field between the nozzle and the plant leaf is generated by charging droplets. The attraction between small, charged droplets and the plant canopy is expected to provide the additional force to move droplets toward the plants and resist drift. ■

Source: Adapted from Reducing Spray Drift, Extension Bulletin 816, by H. Erdal Ozkan, Professor, Dept. of Agricultural Engineering, Ohio Cooperative Extension Service, The Ohio State University.

EPA REGIONAL OFFICES

REGION 1 ***(CT, MA, ME, NH, RI, VT)***
1 Congress Street, Suite 1100
Boston, MA 02114-2023
617-918-1111

REGION 2 ***(NJ, NY, Puerto Rico, Virgin Islands)***
290 Broadway
New York, NY 10007-1866
212-637-3660

REGION 3 ***(DC, DE, MD, PA, VA, WV)***
1650 Arch Street (3PM52)
Philadelphia, PA 19103-2029
215-814-5000

REGION 4 ***(AL, FL, GA, KY, MS, NC, SC, TN)***
Sam Nunn Atlanta Federal Center
61 Forsythe Street, SW
Atlanta, GA 30303
404-562-9900

REGION 5 ***(IL, IN, MI, MN, OH, WI)***
77 W. Jackson Boulevard
Chicago, IL 60604
312-353-2000

REGION 6 ***(AR, LA, NM, OK, TX)***
1445 Ross Avenue
Dallas, TX 75202
214-655-6444

REGION 7 ***(IA, KS, MO, NE)***
901 N. 5th Street
Kansas City, KS 66101
913-551-7003

REGION 8 ***(CO, MT, ND, SD, UT, WY)***
1595 Wynkoop St.
Denver, CO 80202-1129
303-312-6312

REGION 9 ***(American Samoa, AZ, CA, NV, Guam, HI)***
75 Hawthorne Street
San Francisco, CA 94105
415-947-8000

REGION 10 ***(AK, ID, OR, WA)***
1200 6th Avenue, Suite 900
Seattle, WA 98101
206-553-1200

HOW TO REDUCE PESTICIDE WASTE

Follow IPM Practices

The first step in reducing pesticide waste is to determine how much pest damage can be allowed before pesticide use is warranted. Examine alternative controls before purchasing pesticides. The need for pesticides, and, consequently, the risk of surface and ground water contamination, can be reduced through various Integrated Pest Management (IPM) practices such as scouting, crop rotation, fallowing, planting resistant cultivars, alternating pest control products, and considering economic thresholds. Many row-crop growers are reexamining the costs and benefits of mechanical cultivation for controlling weeds. Studies indicate that a combination of mechanical cultivation and banding herbicides provides adequate weed control while greatly reducing pesticide use.

Purchase Only What You Need

Avoid the problems with unused products (undiluted pesticide concentrate) by checking your storage area each year before purchasing chemicals. Buy only what you can use in one growing season. Store unused pesticides properly for use the following season. Contact your county Extension office for information on proper pesticide storage.

Improve Application Accuracy

Check the accuracy of your sprayer periodically to make sure you are applying the amount recommended on the pesticide label. Guidelines established by the U.S Department of Agriculture and the Environmental Protection Agency indicate that the difference between a sprayers actual application rate and intended application rate should not exceed 5 percent of the intended rate. However, surveys conducted in Ohio and other states indicate that only one out of four sprayers is applying chemicals with application errors less than 5 percent. Calibrating a sprayer is not difficult, and detailed information is available from your local county Extension office.

Eliminate Leftover Spray Mixture

Avoid leftover diluted pesticide in your spray tank following a pesticide application. A few simple calculations can be used to determine the amount of spray mixture needed to spray a given size of field. Follow these steps to determine the amount of water and pesticide concentrate you need to add to the tank:

1. Determine the area to be sprayed (acres, square feet etc.)
2. Multiply this area by the application rate of the sprayer to find the amount of spray mixture needed in gallons.
3. Multiply the area to be treated by the pesticide rate to determine the amount of pesticide you must add to the tank.

Example:
A sprayer has been calibrated to apply 15 gallons of spray mixture per acre. The pesticide label recommends 2 pints of commercial product per acre for broadcast application. Determine how much water and pesticide must be added to cover 10 acres.

Spray Mixture Needed
= Spray Output (GPA) x Acres to be Sprayed
= 15 gal/acre x 10 acres = 150 gallons of spray mixture

Amount of Pesticide Needed
= 10 acres x 2 pints/acre = 20 pints (2.5 gallons)

So, if the total solution should be 150 gallons, the final mixture should contain 147.5 gallons water and 2.5 gallons of pesticide formulation.

Calibrate your sprayer to determine the actual application rate.

Rinse Containers Immediately

Concentrated pesticide residues leaking from unrinsed, discarded containers can cause significant environmental contamination. Up to 3 ounces of pesticide may be left inside a 5-gallon container after normal emptying. Depending on the cost of the product, the money saved in pesticide cost alone through proper container rinsing could be significant. Containers should be rinsed immediately after they are emptied because residue can dry and become difficult to remove.

Triple rinsing is the most common procedure for rinsing containers. It involves filling each container at least one-quarter full with water, replacing the lid, shaking the container, and then emptying the liquid from the container into the spray tank. This is done three times with each container. A new approach, pressure rinsing, allows containers to be rinsed while pesticides are emptied into the spray tank. Special nozzles attached to a garden hose are used to puncture plastic and metal containers. When turned on, the nozzle produces a forceful spray inside the empty container. By holding the container over the opening of the spray tank or holding tank while rinsing, the rinse water can be captured as it drains from the container spout. It takes a few minutes to properly triple rinse a container, but less than a minute to pressure rinse. The amount of rinsate generated is also reduced with the pressure-rinsing method.

Reduce Rinsate

Spray equipment requires periodic cleaning and rinsing to keep vital components in good working condition and when switching from one pesticide to another. Improper management of rinsate has great potential for contaminating surface and ground water. The best way to eliminate this problem is to perform all interior and exterior rinsing in the field immediately following the application. Equipment may also be

rinsed at a modern pesticide mixing and loading facility equipped with a concrete rinse pad and rinsate-collection pit. However, disposal of the rinsate collected in the pit could become a major problem. This is why it is important to reduce the amount of rinsate to a minimum. If possible, reuse the rinsate when preparing the next batch of tank mixture. Make sure all the dirt and debris in the rinsate are filtered out before adding the rinsate to the spray tank. The small amount of solids left in the collection pit should be dried and taken to a hazardous waste disposal site or spread evenly over a large part of the field. Information on constructing a rinse pad and pesticide-storage facility is available at your local county Extension office.

Modify Spraying Equipment

Take advantage of technological advancements in pesticide application equipment design, and modify your equipment to improve application efficiency while reducing pesticide waste. Recent developments in pesticide application equipment allow for safer operation and less risk to the applicator and the environment. For example, sprayers with in-line pesticide-injection systems eliminate leftover tank mixtures. With these systems, the pesticide and water are kept in separate tanks. A separate metering pump feeds the pesticide into the spray line. Any excess water is left in the water tank, and excess pesticide remains in the pesticide tank.

Many new sprayers are equipped with a small tank that holds clean water to rinse out the sprayer tank in the field. Immediately following the application, clean water can be pumped into the large spray tank, and the rinse water can be sprayed over the target field, provided registered rates are not exceeded and application is consistent with label directions.

Research is under way to develop new equipment and methods that will further improve application efficiency. For example, researchers are developing systems that automatically adjust pesticide rates according to the amount of organic matter in the soil. This system operates on the principle that lighter soils, which are low in organic matter, require less pesticide than darker soils.

Some studies indicate that ultra-low volume (ULV) pesticide applications using electrostatic nozzles provide satisfactory insect control at half the rate recommended for conventional spraying. Such techniques mean greater pesticide efficiency and less pesticide consumption, which results in reduced pesticide waste.

Choose Pesticides Packaged In Returnable/Refillable Containers

Many agricultural chemical companies have developed new pesticide packaging to protect users from exposure and reduce pesticide waste. For example, mini-bulk containers, ranging in volume from about 40 to 600 gallons, have become increasingly popular over the last few years. Mini-bulk

containers reduce the number of small containers, which are major sources of pollution. Mini-bulk tanks usually are returned to the dealer for refilling or for deposit. Nearly every major company offers a mini-bulk for one or more of its products.

While some companies are promoting small-volume returnable containers, others are trying to eliminate the container altogether. One company has pressed dry pesticide into an effervescent tablet that can be broken into small parts for reduced applications or used whole at full strength for normal applications. Another company is packaging pesticides in small water-soluble pouches that improve safety in normal handling and eliminate problems with container rinsing and disposal.

Some equipment manufacturers and agricultural chemical companies are joining forces to reduce pesticide waste and improve applicator safety. Returnable chemical containers are being designed to fit directly into a valve on the lid of a planter's pesticide hopper. This reduces the risk of the applicator inhaling pesticide dust, which is a recurrent problem with conventional dry granular pesticide packaging.

Source: Adapted from Bulletin 819, “Reducing Pesticide Waste”, by H. Erdal Ozkan and Mark L. Wilson, the Ohio State University Extension

ID-100

COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

Understanding Pesticide Labels and Labeling*

Prepared by M.P. Johnson, Department of Entomology
**Adapted from Video Instructional Programs, Evansville, Indiana*

What Is a Pesticide?

A pesticide, as defined by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), is ". . . any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any insect, rodent, nematode, fungus, weed, or any other forms of life declared to be pests; and any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant."

Pesticide labels and labeling provide essential directions for the sale and responsible use of these chemicals. The pesticide user is legally responsible to follow all label and labeling directions.

It is a violation of federal law to use pesticide products in a manner inconsistent with their labeling. However, "inconsistent with labeling" does not include:

- applying a pesticide at any dosage, concentration, or frequency **less than that specified on the labeling**,
- applying a pesticide against any target pest not specified on the labeling if the application is to a crop, animal, or site specified on the labeling,
- employing any method of application not prohibited by the labeling, or
- mixing a pesticide or pesticides with a fertilizer when such mixture is not prohibited by the labeling.

The user is personally liable if a pesticide application results in unwanted damage. Chemical companies are very careful to include disclaimers on their products' labels, which transfers all risks to the buyers of their products.

A LABEL— Refers only to information printed on the product container. All labels, which are essentially the manufacturer's license to sell, provide the important facts about Distribution, Storage, Sale, Use, Disposal, and Safety Measures Required for the Pesticide.

LABELING— Refers to any information printed on, attached to, or accompanying your purchase. This may include such things as brochures, leaflets, and information handed out by your dealer.

Pesticide Registration

Registration of pesticides is designed to protect people and the environment from abuse of pesticide use. FIFRA was primarily a labeling law and was originally administered by the U.S. Department of Agriculture. It has been amended several times to increase and expand the protection of users of pesticides, our food and the environment.

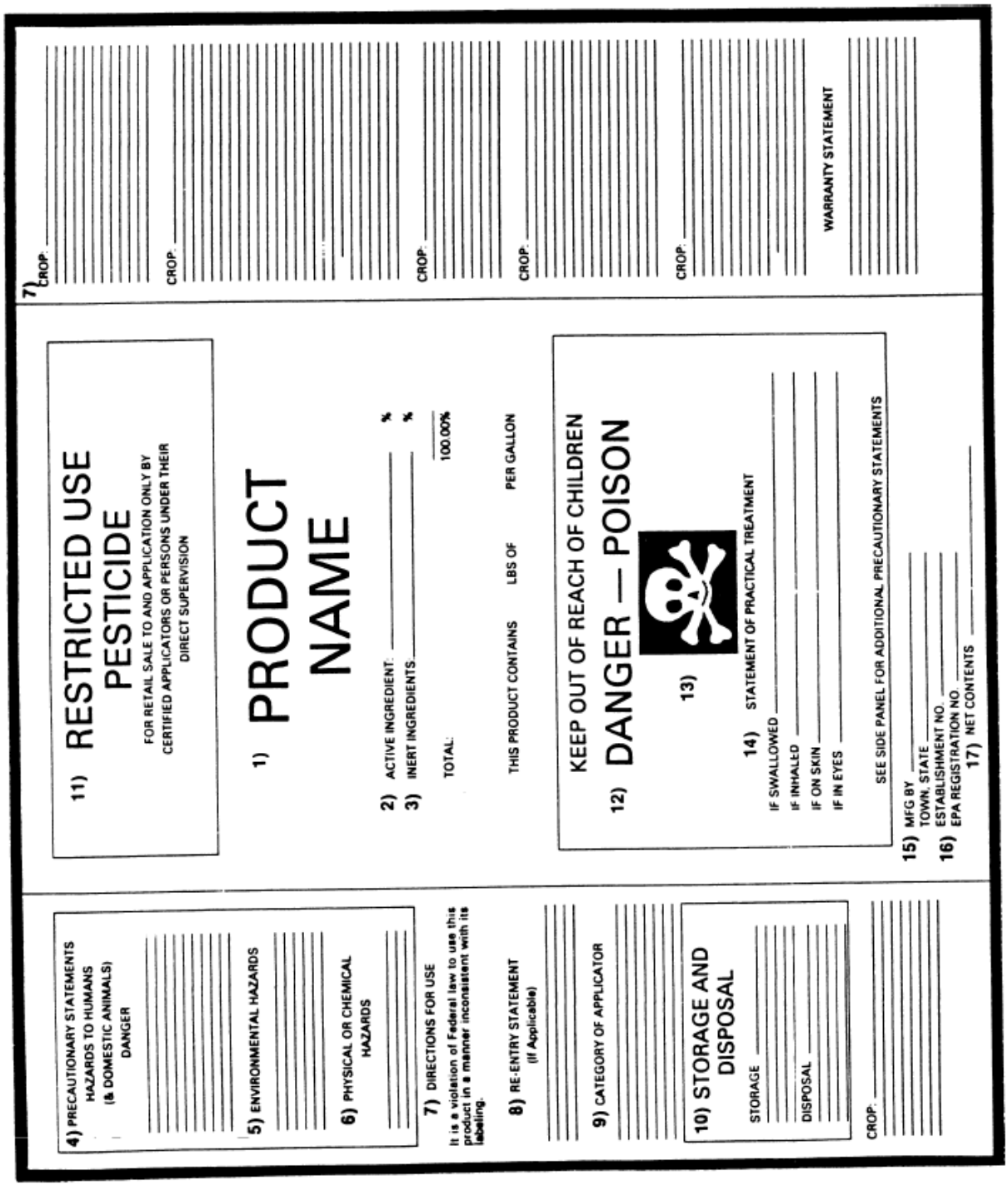
Amendments made in 1972 require that pesticides be classified for either general or restricted use. Further, people who apply restricted use pesticides either commercially or privately are required to be certified by their respective states.

Major Types of Pesticide Label Registrations

Different procedures can be used to register a pesticide and its label with the Environmental Protection Agency (EPA). The following are the major types:

- Section 3. This type requires normal procedures (see "Data Requirements for Registration") to register a pesticide and its label with the EPA. The vast majority of pesticide registrations are in this category.
- Section 18. Emergency Exemption. This type involves an urgent, nonroutine situation that requires the use of pesticide(s). The EPA places three conditions on this type of registration:
  1. no effective registered pesticides are available,
  2. no feasible alternative control practices are available, and
  3. the situation involves the introduction of a new pest or will present significant risks to human health or the environment or will cause significant economic loss.

  All Emergency Exemptions are considered Restricted Use materials and require applicator certification despite the nature of the product for regular uses. A copy of the supplemental Emergency Exemption label must be with the product while in use. Also, Crisis Emergency Exemptions can be issued in exceptional situations. Please see fact sheet PATFACT 005, Pesticide Registrations: Section 18 Emergency Exemption, for more information.


11) RESTRICTED USE PESTICIDE
FOR RETAIL SALE TO AND APPLICATION ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION
1) PRODUCT NAME
2) ACTIVE INGREDIENT: %
3) INERT INGREDIENTS: %
TOTAL: 100.00%
THIS PRODUCT CONTAINS LBS OF PER GALLON
KEEP OUT OF REACH OF CHILDREN
12) DANGER — POISON
13)
14) STATEMENT OF PRACTICAL TREATMENT
IF SWALLOWED
IF INHALED
IF ON SKIN
IF IN EYES
SEE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS
15) MFG BY
TOWN, STATE
16) ESTABLISHMENT NO.
EPA REGISTRATION NO.
17) NET CONTENTS
7) CROP:
CROP:
CROP:
CROP:
CROP:
WARRANTY STATEMENT
4) PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS (& DOMESTIC ANIMALS) DANGER
5) ENVIRONMENTAL HAZARDS
6) PHYSICAL OR CHEMICAL HAZARDS
7) DIRECTIONS FOR USE
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
8) RE-ENTRY STATEMENT (If Applicable)
9) CATEGORY OF APPLICATOR
10) STORAGE AND DISPOSAL
STORAGE
DISPOSAL
CROP:

- Section 24(c). Special Local Needs. This type involves an existing or imminent pest problem within a state for which the State Lead Agency (Division of Pesticides), based on satisfactory supporting information, has determined that an appropriate Federally registered product is not sufficiently available. Special Local Needs (SLN) registrations allow for supplemental labeling of a Section 3 label. These registrations are particularly useful in providing needed pest control materials for minor uses. Please see fact sheet PATFACT 006, Pesticide Registrations: Section 24(c) Special Local Needs, for more information.

Data Requirements for Registration

As specified in amended FIFRA, all pesticides must be registered. This includes all pesticides used in and around homes; swimming pools, businesses, public buildings, and in agriculture. Before any registration is issued, however, the manufacturer (applicant) must submit data to the Pesticide Registration Division of the EPA showing that the product when used as directed:

- is effective against the pest(s) listed on the label,
- will not injure humans, animals, or crops, or damage the environment, and
- will not result in illegal residues on feed and food.

Parts of the Label

Please refer to the figure of a label on page 2.

1. BRAND NAME—Appears boldly on the label. It is the name by which the product is advertised.

Common name—The same chemical may appear on the shelf under several brand names, but the common name, or chemical name, may be the same.

For example, carbaryl is the common name for Sevin. Its chemical name, 1-naphthyl N-methylcarbamate, is difficult to remember.

Ingredient statement—Two kinds of ingredients form pesticides: active ingredients and inert ingredients.

2. ACTIVE INGREDIENTS—Listed by either chemical name or common name. Must be stated as a percentage by weight or pounds per gallon of concentrate.

3. INERT INGREDIENTS—Need not be listed on most products, but percent of their content must be. Inert ingredients are currently placed into four categories by the EPA. They include:

- Inerts of toxicological concern,
- Potentially toxic inerts (high priority),
- Inerts of unknown toxicity, and
- Inerts of minimal concern.

Types of Formulations—Pesticides come in different forms: liquids, wettable powders, dusts, etc. Each form is handled differently, and the label identifies the formulation. An example is 4E, which means it is an emulsifiable concentrate (E) with 4 pounds of active ingredient per gallon. Emulsifiable concentrates can also be represented by EC.

Other common types of formulations include:
F, L, or FL *Flowables*
ULV *Ultra Low Volume*
D *Dusts*
B *Baits*
G *Granulars*
P or PS *Pellets*
W or WP *Wettable Powders*
S or SP *Soluble Powders*
DF Dry *Flowables*
WDG *Water Dispersable Granules*
WDL *Water Dispersable Liquids*

Other less common formulations include:
AF *Aqueous Flowables*
AS *Aqueous Suspensions*
ES *Emulsifiable Solutions*
MTF *Multiple Temperature Formulation*
OL *Oil-soluble Liquids*
SL *Slurrys*

Microencapsulation Liquid or dry pesticide particles may be surrounded by a plastic coating to produce a microencapsulated formulation.

Precautionary Statement

4. HAZARDS TO HUMANS AND DOMESTIC ANIMALS—These statements warn you of possible poisoning to humans and animals. Special precautions, including necessary protective equipment, appear here. If the product carries serious risk, proper poison treatment is listed.

5. ENVIRONMENTAL HAZARDS—Warnings here may include general statements about birds, fish, and wildlife or include statements concerning toxicity to honeybees, surface and groundwater contamination, and endangered species. Label information on groundwater contamination warns against applying pesticides in situations which may lead to contamination of groundwater.

6. PHYSICAL AND CHEMICAL HAZARDS—Warnings appear here about potential fire, explosion, or chemical hazards.

7. DIRECTIONS FOR USE—Explanation of correct use of the product. Also tells you what pests the product is registered to control, where the product can be used, when it should be used, how much to use, and in what form to use it. This section also says whether the product is for general or restricted use.

Misuse statement

You are warned here that if you fail to follow label directions exactly, you are violating federal law.

Worker Protection Standard (WPS)

Labels of agricultural pesticides will require compliance with the Worker Protection Standard (WPS). This part of the label will usually be called "Agricultural Use Requirements." You must comply with ALL the revised WPS requirements if you are affected by WPS.

8. REENTRY STATEMENT—Some products require that a person without protective clothing not enter the treated area until a certain amount of time has passed. Consult local authorities for special rules that may apply.

9. CATEGORY OF APPLICATOR—If required for this product, this section will limit use to certain categories of commercial applicators.

10. STORAGE AND DISPOSAL DIRECTIONS—Pesticide labels will have some basic guidelines for pesticide storage, usually recommending that they be stored in a cool, dry, well-ventilated area away from feed and foodstuffs. And different types of pesticides should be stored separately: herbicides separate from insecticides as an example. The pesticide storage area should be well marked with warning signs and be locked to prevent unauthorized entry. Improper disposal of excess pesticide, spray mixture, rinsate, or the container is a violation of federal law. If these wastes cannot be disposed of according to label directions, contact the Kentucky Division of Waste Management (502) 564-6716, or the National Pesticide Telecommunication Network (800) 858-7378 (24 hour), for guidance.

NOTE: Burning pesticide containers is illegal in Kentucky.

11. STATEMENT OF USE CLASSIFICATION—The label must show whether the pesticide is for general or restricted use. Use is based on the hazard of poisoning, the way the pesticide is used, and its effect on the environment.

General use—According to FIFRA, a general use pesticide is one that, when applied according to its directions, will not generally cause unreasonable adverse effects on the environment.

Restricted use—Restricted use pesticides have a statement at the top of the label's front panel saying "Restricted use pesticide for retail sale to and application only by certified applicators or persons under their direct supervision." According to FIFRA, a restricted use pesticide is one that, when applied according to its directions, may generally cause unreasonable adverse effects on the environment, including injury to the applicator.

12. SIGNAL WORDS—Signal words, standard by law in the industry, tell you how severely toxic a pesticide is. The three signal words used on pesticide labels are DANGER, WARNING and CAUTION. Pesticides with the signal word DANGER are most toxic or hazardous and their use is normally restricted. They will usually have the word "Poison" and the skull and crossbones on the label.

Less toxic pesticides may be given the signal word WARNING if there is a specific hazard, such as severe skin or eye injury, or a particular danger to the environment. For these, the word "Poison" or the skull and crossbones is not on the label. Pesticides with the signal word CAUTION are least toxic to people and are generally less hazardous. Every product label must have "Keep Out of the Reach of Children" and carry one of the signal words:

Signal Word	*Toxicity*	*Approximate Amount Needed to Kill 50% of a Laboratory Population of Test Animals (Mice, Rats, Etc.) if Taken Orally*
DANGER	*Highly Toxic*	*A taste to ½ of an ounce*
WARNING	*Moderately Toxic*	*½ ounce to a little over an ounce*
CAUTION	*Slightly Toxic*	*A little over an ounce to more than a pint (16 ounces)*

13. SYMBOL—The skull and crossbones symbol attracts attention to highly toxic materials. The symbol is accompanied by the signal word DANGER and the word POISON.

14. STATEMENT OF PRACTICAL TREATMENT—Emergency first aid is spelled out in this section. In addition, you are told what exposure requires medical attention, such as swallowing or inhaling the product or getting it in your eyes or on your skin. In the case of a possible poisoning, it is important to take the pesticide label to the attending physician.

15. NAME AND ADDRESS OF MANUFACTURER—The law requires the manufacturer to identify itself by name and address.

16. REGISTRATION AND ESTABLISHMENT NUMBERS—The registration number shows that the product is properly registered with the federal government (Environmental Protection Agency). The establishment number identifies the factory and appears on the container but may not be on the label.

17. NET CONTENTS—The net contents tells you the amount in the container.

The following Cooperative Extension publications give more information on pesticides.

- ***Commercial Vegetable Crop Recommendations*** (ID-36) (revised every two years. Be sure to use the most current version.)
- ***Kentucky Commercial Tree Fruit Spray Guide*** (ID-92) (revised every year)
- ***Kentucky Commercial Small Fruit Spray Guide*** (ID-94) (revised every year)
- ***Guidelines for Pesticide Use*** (ID-98)
- ***Insect Management Recommendations for Field Crops and Livestock*** (revised every year)
- ***Chemical Control of Weeds in Kentucky Farm Crops*** (AGR-6) (revised every year)
- ***Herbicide Persistence and Carryover in Kentucky*** (AGR-139)
- ***Herbicides with Potential to Carry Over and Injure Rotational Crops in Kentucky*** (AGR-140).
- ***Agricultural Chemical Storage and Handling*** (IP-41) (Part of the Kentucky Assessment System or KY•A•Syst)

Issued 6-90; Revised/Printed 4-97, 5000 copies; 29000 copies to date.

KENTUCKY STATE POLICE POSTS

POST 1
Graves County
Seat: Mayfield
270-856-3721

POST 2
Hopkins County
Seat: Madisonville
270-676-3313

POST 3
WarrenCounty
Seat: Bowling Green
270-782-2010

POST 4
Hardin County
Seat: Elizabethtown
270-766-5078

POST 5
Henry County
Seat: Campbellsburg
502-532-6363

POST 6
Grant County
Seat: Dry Ridge
859-428-1212

POST 7
Madison County
Seat: Richmond
859-632-2404

POST 8
Rowan County
Seat: Morehead
606-784-4127

POST 9
Pike County
Seat: Pikeville
606-433-7711

POST 10
Harlan County
Seat: Harlan
606-573-3131

POST 11
Laurel County
Seat: London
606-878-6622

POST 12
Franklin County
Seat: Frankfort
502-227-2221

POST 13
Perry County
Seat: Hazard
606-435-6069

POST 14
Boyd County
Seat: Ashland
606-928-6421

POST 15
Adair County
Seat: Columbia
270-384-4796

POST 16
Henderson County
Seat: Henderson
270-826-3312

MIXING PROCEDURE FOR FILLING HERBICIDE SPRAY TANKS

1. Fill tank 1/3 (one-third) full with water.

2. Start agitation.

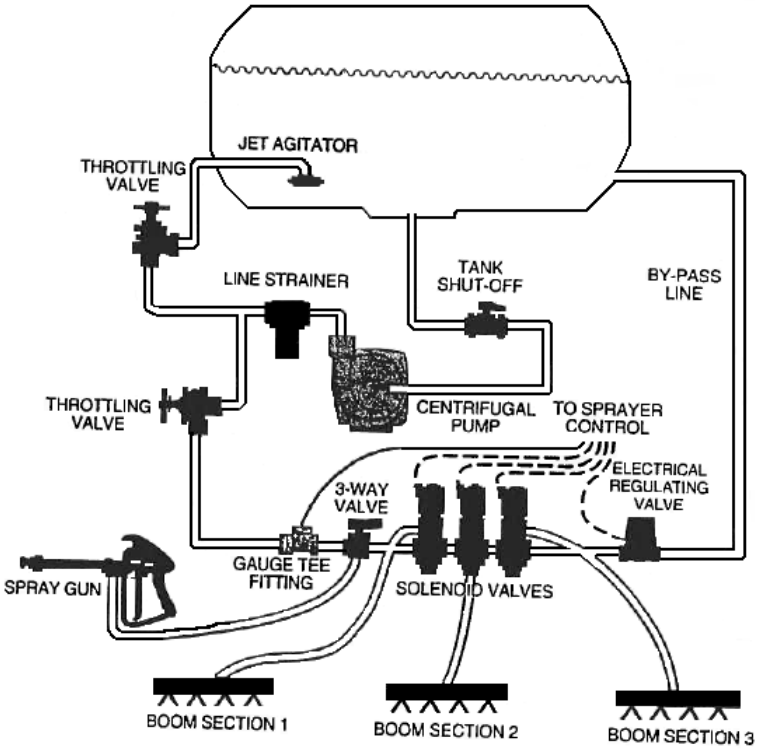
3. Add defoamer.

4. Add dry flowables (DF), water dispersible granules (WDG), and wettable powders (WP) and then agitate until dispensed in water.

5. Next, add any solution (S) products. Surfactant can be added at this time.

6. Add Emulsifiable Concentrate (EC) products, agitate and finish filling the tank with water.

7. Drift control agent should be added at this time.



NON-POSITIVE DISPLACEMENT PUMP

The centrifugal pump is the most common non-positive displacement pump. The output from this type of pump is influenced by pressure. This pump is ideal for delivering large volumes of liquid at low pressures. A key component of the centrifugal pump is the throttling valve. A manual throttling valve on the main output line is essential for the accurate operation of the centrifugal pump.

Kentucky Transportation Cabinet
Division of Maintenance

TC 71-226
11/2015

NOXIOUS WEED CONTROL REQUEST

I, _____, hereby request that the Department of Highways take measures to control one or more of the following weeds that have been declared noxious by the State of Kentucky under Statute Number 176.051.

- ☐ Johnsongrass
- ☐ Giant Foxtail
- ☐ Musk or Nodding Thistle
- ☐ Canada Thistle
- ☐ Poison Hemlock
- ☐ Japanese Knotweed
- ☐ Marestail
- ☐ Amur Honeysuckle
- ☐ Kudzu
- ☐ Multiflora Rose
- ☐ Common Teasel

I own property in _____ County, which is adjacent to State Route _____ located between milepoints _____ and _____. I also understand that to be eligible for this program I must be engaged in a weed control practice of one or more of the above noted weeds on my property, which is located adjacent to the stated right-of-way.

_____
Signed

_____
Date

_____
Contact Number

PAT-6
COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

Personal Protective Equipment for Pesticide Applicators

Monte P. Johnson, Elizabeth P. Easter, and S.W. Horstman

Pesticides provide many benefits but can be hazardous if not used safely. We must learn to respect pesticides and the potential problems that can result from applying them in the wrong way. Personal exposure should be a major concern to anyone handling or otherwise coming into contact with pesticides. Consequently, this publication will cover some of the major subjects surrounding exposure to pesticides and how to prevent it.

Symptoms of Poisoning

One hindrance to better protection habits is that pesticide users often do not recognize that they have been poisoned. Often symptoms of pesticide poisoning are much like flu symptoms:

Symptoms of pesticide poisoning:

- nausea
- headache
- dizziness
- chest discomfort
- skin blisters
- diarrhea
- blurred vision.

Symptoms of advanced poisoning:

- vomiting
- difficulty in breathing
- drooling
- pinpoint pupils of eyes
- unconsciousness.

Pesticide Labels and Signal Words

Before opening a pesticide container, carefully **read the label**. Pesticide product labels have "signal words" that clearly indicate the level of toxicity and the level of risk to the user. The following table lists the three different signal words and what they mean on a pesticide label:

Signal Word	Toxicity Class	Toxicity	Approximate Amount Needed to Kill 50% of a Laboratory Population of Test Animals (Mice, Rats, etc. If Taken Orally)
DANGER	I	Highly toxic	Taste to 1/8 of an ounce.
WARNING	II	Moderately toxic	1/8 of an ounce to a little over an ounce.
CAUTION	III	Slightly toxic	A little over an ounce to more than a pint (16 ounces).
CAUTION	IV	Almost nontoxic	Well over a pint (16 ounces).

Routes of Exposure

Pesticide labels describe the pesticides' routes of entry into your body. Examples are: "Poisonous if **swallowed, inhaled, or absorbed through the skin**." Or "rapidly **absorbed through the skin and eyes**."

Research has shown that pesticides are absorbed through the skin at different rates on various parts of the body. Special protection should be given to the scalp, ear canal, and forehead areas. The groin area should also be protected. Since hands and forearms are the most likely places of exposure, they should always be protected when handling pesticides. **Figure 1** shows different rates of absorption through the skin on different parts of the body.

Personal Protective Equipment

Many different types of Personal Protective Equipment (PPE) are available through safety supply businesses and catalogs, pesticide dealers, and garden, nursery and forestry supply houses.

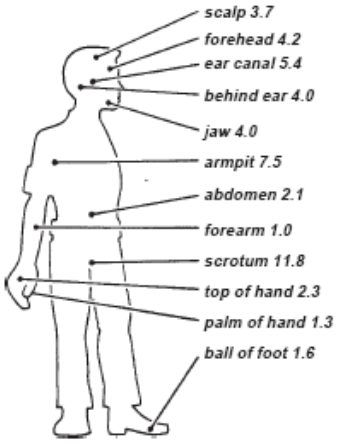


Figure 1. — Rates of Pesticide Exposure Through the Skin.

Rates of absorption through the skin are different for different parts of the body. Compared to dermal absorption rate through the forearm (absorption rate of 1), absorption through the groin area would be more than 11 times faster.

Gloves

When the pesticide label recommends gloves, wear **chemically-resistant gloves**. Chemical resistance means that pesticides will not pass through the glove material.

- Always check the label for appropriate gloves to wear.
- Never wear leather, fabric, or fabric-lined gloves.
- Use gloves that extend at least to the mid-forearm.
- Consider shoulder-length gloves or gloves and chemically-resistant sleeve guards for mixing and loading.
- Replace gloves often — check for holes and leaks.
- Never place contaminated hands in gloves.

Coveralls and Aprons

Some pesticide labels may recommend a long-sleeved shirt and long-legged pants of sturdy, woven fabric. Many pesticide labels require coveralls worn over shirt and pants. Some labels will require chemically-resistant suits with sealed seams.

Coverall materials include:

- Woven: cotton or cotton/polyester in at least 7 to 10 oz. twill (denim, chino, drill)
- Nonwoven: made by bonding fibrous webs, traditionally disposable
- Chemical-resistant: plastic or rubber materials or fabrics coated with water-resistant finishes.

Wear sleeves outside gloves and pant legs outside boots.

Chemically resistant aprons can be worn when mixing and loading pesticides or cleaning equipment.

- Sleeveless aprons protect against spills and splashes to the body front.
- Aprons with sleeves, but open in the back, reduce exposure to the shoulders, arms, and body front and are more comfortable to wear than coveralls.

Boots

- Select unlined, waterproof boots that reach at least halfway to the knee.
- **Do not** wear leather or canvas shoes or boots; if a pesticide is spilled or sprayed on these materials, they cannot be thoroughly cleaned. If contaminated shoes or boots become wet, the pesticide(s) can be reactivated.

Headwear

Select a wide-brimmed, waterproof hat that will protect the neck, eyes, mouth, and face. Plastic hard hats with plastic sweatbands are a good choice as they are waterproof. Avoid hats with a cloth or leather sweatband. Cloth or leather sweatbands are difficult or impossible to clean.

Eyewear

Wear protective eyewear when working with dusts, mists, when liquids may splash in your eyes, or when working with pressurized systems.

- **Goggles** with indirect vents provide better eye protection than safety glasses or face shields.
- **Face shields** protect the eyes and face from splashes from liquid pesticide formulations and may be worn over goggles for extra protection.

- **Safety glasses** with side shields and brow guards are recommended for some situations.
- Avoid wearing contact lenses when handling pesticides.

Respirators

The lungs and lining of the respiratory system readily absorb pesticide dusts, mists, and vapors. Respiratory protection is recommended during mixing and loading pesticides, even if not required on the label. Respirator filters either chemically change the pesticide into a harmless form or a solid form that will be trapped inside the filter.

Different cartridges are available to protect against a variety of chemical gases and vapors. Replace the cartridge according to the manufacturer's recommendations as soon as you begin to smell pesticide coming through the respirator, or if breathing becomes difficult.

Respirator Types:

- Half-mask, Particulate, Disposable — for dusts, pollen, mists, welding fumes, and certain pesticides applied in solid form
- Half-mask, Dual Cartridge, Disposable — for pesticides and ammonia
- Half-mask, Dual Cartridge, Reusable — for variety of contaminants

- Full-face, Dual Cartridge, Reusable — for variety of contaminants
- Air-Purifying with Helmet — for variety of contaminants
- Canister-type Gas Mask — for variety of contaminants
- Self-Contained Breathing Apparatus (SCBA) — used for entry and escape from all atmospheres Immediately Dangerous to Life or Health (IDLH) or oxygen deficient.

When Using a Respirator:

- Be sure you have a tight fit on your face to prevent leaks (facial hair may prevent an adequate fit).
- Dust/mist filtering respirators protect against dusts, powders, mists, and sprays. Look for NIOSH/MSHA approval number prefix TC-21C.
- Vapor-removing respirators protect against gases and vapors. Choose a cartridge approved for organic vapors/pesticides plus a pesticide prefilter, both with NIOSH/MSHA approval number prefix TC-23C, or a canister approved for pesticides/organic vapors with NIOSH/MSHA approval number prefix TC-14G.

Inspecting, Maintaining, and Replacing PPE

PPE should be disposable or sturdy enough to be cleaned for repeated use. To remain effective, PPE must be maintained properly and replaced as necessary.

Disposables

Disposables are PPE items not designed to be cleaned and reused. However, if recommended by the manufacturer, some disposable coveralls can be laundered several times before being discarded. Discard them when they become contaminated with pesticides.

Reusables

Reusables are PPE items designed to be easily cleaned and reused. However, do not reuse items that can no longer provide adequate protection.

- Rubber and plastic suits, gloves, boots, aprons, and headgear should be washed thoroughly between uses. Inspect carefully for holes or thin places.
- Fabric clothing should be cleaned after each day's use.
- Clothing that is heavily contaminated should be discarded.
- Place items in a labeled plastic bag or hamper away from other personal clothes and away from family laundry.
- Eyewear and respirators should be cleaned after each day's use. Store where they are protected from dust, sunlight, extreme temperatures, excessive moisture, pesticides, and other chemicals. A zip-closable sturdy plastic bag works well for storage. Check respirator valves for wear and replace them if needed. These items should last many years if they are good quality and maintained correctly.

Washing PPE

Do not allow contaminated or soiled PPE items to be washed with the regular family laundry. It could cause other items to become contaminated. Wear chemically resistant gloves when handling contaminated or soiled PPE.

Boots, helmets, goggles, respirators, and other bulky items can be washed by hand. Other items can be washed as follows:

1. Pre-rinse in a washing machine or by hand.
2. Wash in a washing machine, using a heavy-duty detergent and hot water for the wash cycle.
3. Wash only a few items at a time to allow plenty of agitation and water for dilution. Use the highest water-level setting.
4. Rinse twice using two rinse cycles and warm water.
5. Use two entire machine cycles to wash items that are moderately to heavily contaminated.
6. Run the washer through at least one additional entire cycle without clothing, using detergent and hot water, to clean the machine.

Drying PPE

Hang the items to dry outdoors, if possible, as the sunlight and fresh air will help remove remaining pesticide residues. If it is not possible to air dry, then using a clothes dryer is acceptable for fabric items. However, the dryer can become contaminated with pesticide residues over time.

Avoiding Heat Stress

Heat stress is the illness that occurs when the body builds up more heat than it can cope with. Severe heat stress (heat stroke) can result in death. Signs and symptoms of heat stress may include:

- Fatigue (exhaustion, muscle weakness)
- Headache, nausea, and chills
- Dizziness and fainting
- Loss of coordination
- Severe thirst and dry mouth
- Altered behavior (confusion, slurred speech, quarrelsome or irrational attitude).

Anyone showing signs and symptoms of heat stress should be treated immediately.

Heat stress is not caused by exposure to pesticides, but may affect pesticide handlers who are working in hot conditions. Wearing PPE can increase the risk of heat stress by limiting the body's ability to

cool down. The following suggestions can help reduce the chance of heat stress:

- Don't wear extra PPE if you don't need it! Use the minimum amount of PPE that will provide adequate protection.
- Select the coolest PPE required for the job — woven fabrics (cotton, cotton/polyester) allow air to pass through fairly easily. Some recently developed disposable garments also provide some ventilation.
- During heat stress conditions drink plenty of water before, during, and after work — don't rely on thirst as an indicator of how much fluid your body needs.
- Work during the coolest times of day (if possible).
- Use work/rest cycles — take frequent breaks.

Additional Information

Kentucky Cooperative Extension Service Publications
(contact your local county Extension office)

Core Manual: Applying Pesticides Correctly: A Guide for Private and Commercial Applicators
PAT 2 — Kentucky's Pesticide Applicator Training and Certification Program
PAT 3 — Sprayer Nozzles: Selection and Calibration
PAT 4 — Greenhouse Pesticides and Pesticide Safety
PAT 5 — NAPIAP in Kentucky
ENT 53 — Vendors of Beneficial Organisms in North America
ENT 54 — Vendors of Microbial and Botanical Insecticides and Insect Monitoring Devices
ID 98 — Guidelines for Pesticide Use
ID 100 — Understanding Pesticide Labels and Labeling
ID 103 — Kentucky's Endangered and Threatened Species
IP 9 — Pesticide Residues in Grains, Vegetables, Fruits, and Nuts
IP 11 — Residues in Animal-Derived Foods
IP 13 — Protecting Kentucky's Groundwater: A Grower's Guide
HE 2-319A — Tips for Laundering Pesticide-Contaminated Clothing
Special Report 91-1 — Kentucky Pesticide User Practices and Alternatives, 1990
Special Report 92-2 — Kentucky Pesticide User Practices and Alternatives, 1991
Special Report 93-2 — Kentucky Pesticide User Practices and Alternatives, 1992. Includes comprehensive summaries for 1990-1992.

PESTICIDE EMERGENCY TELEPHONE NUMBERS

Pesticide Spills

If you have a pesticide spill and need information on how to handle this type of emergency, call: **911**

Kentucky Environmental Response — **(800) 928-2380**

CHEMTREC Pesticide Emergency Hotline (24 hour) — **(800) 424-9300**

Disaster Emergency Service (24 hour);
State Coordinating Agency for Disasters and Emergencies — **(502) 564-7815**

Division of Pesticides, Kentucky Department of Agriculture — **(502) 564-7274**

Kentucky Department of Human Resources — **(502) 564-4537**

Pesticide Exposures

If you have a person who has been exposed to a particular pesticide, provide your physician or emergency room with these emergency numbers, designed to provide pharmacological information on pesticides to health professionals:

The Kentucky Regional Poison
Center of Kosair Children's Hospital — **(800) 722-5725**

In Metro Louisville call — **589-8222**

National Pesticide Clearinghouse — **(800) 858-PEST (7378)**
Texas Tech University Health Sciences Center
School of Medicine
Department of Preventive Medicine and Community Health
Lubbock, TX 79430

Kentucky Cooperative Extension Service Videotapes
(contact your local county Extension office)

V7-ENT-0316 — Applying Pesticides Correctly...The Label Is Your Guide
V8-ENT-0350 — Pesticide Safety Equipment
V8-AEN-0348 — Groundwater and Well Testing Series

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ATTACK PAC
Universal Spill Kit

Pesticide Spills

If you have a pesticide spill and need information on how to handle this type of emergency call:

CHEMTREC Pesticide Emergency Hotline (24 hour)
800-262-8200

Kentucky Environmental Response
800-928-2380

Kentucky Department of Agriculture Division of Pesticides
502- 573-0282

Kentucky Division of Emergency Management (KYEM)
800-255-2587

State Coordinating Agency for Disasters and Emergencies
502-564-7815

Pesticide Exposures

If you have a person who has been exposed to a particular pesticide, provide your physician or emergency room with the following emergency numbers to contact regarding pharmacological information on pesticides.

Kentucky Regional Poison Center
Kosair Children's Hospital
(502) 589-8222
(800) 222-1222

National Pesticide Information Center (NPIC)
800-858-PEST (7378)

National Pesticide Telecommunication Network (NPTN)
800-858-7378

KENTUCKY TRANSPORTATION CABINET
Department of Highways
DIVISION OF MAINTENANCE

TC 71-108
Rev. 01/2014
Page 1 of 1

PESTICIDE FIELD REPORT

SECTION 1: LOCATION INFORMATION

REF. LINE #	DATE	COUNTY	ROUTE	LOCATION MILE POINT	SIDE SPRAYED	WEATHER CONDITIONS	ACTIVITY USED	TARGET SPECIES
1.								
2.								
3.								
4.								
5.								

SECTION 2: PESTICIDE APPLICATION RECORD

REF. LINE #	RATE OF CARRIER	SPRAYER #/APP NAME/CERT #	NAME OF PESTICIDE/ACRE	GALLONS OF SOLUTION/ROUTE	TOTAL PESTICIDE USED/ROUTE
1.			Choose an item.	____/____	____/____
2.			Choose an item.	____/____	____/____
3.			Choose an item.	____/____	____/____
4.			Choose an item.	____/____	____/____
5.			Choose an item.	____/____	____/____

SECTION 3: COMMENTS & SIGNATURE

SUPERVISOR COMMENTS

SUPERVISOR *(signature)*	**DISTRICT**	**DATE** *(submitted)*

EPA Registration Numbers: Arsenal: 241-346; Endurance: 100-834; Proclipse: 228-434; Escort XP: 352-439; Telar XP: 352-654; Oust Extra: 352-622; Oust XP: 352-601; Perspective: 352-846; Steamline: 352-848; Viewpoint: 352-847; Krenite S: 42750-247; Polaris AC Complete: 228-570; Roundup ProMax: 524-579; Glyphosate 5.4: 81927-8; Garlon 3A/Element 3: 62719-37; Garlon 4: 62719-527; Element 4: 62719-40; Fusion: 100-1059; Fusilade II: 100-1084; 2,4-D Amine: 228-145; Outrider: 524-500; Pendulum Aquacap: 241-416; Plateau: 241-365; 2,4-D Dry: 228-260; Transline: 62719-259; Milestone VM: 62719-537; Payload: 59639-120; MSMA 6: 61483-15; Stronghold: 2217-802; BK 800: 2217-758; Overdrive: 7969-150; Opensight: 62719-597; Esplanade: 432-1516; Acclaim Extra: 432-950; AquaNeat: 228-365; Habitat: 241-426.

KENTUCKY TRANSPORTATION CABINET
Department of Highways
DIVISION OF MAINTENANCE

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PESTICIDE FIELD REPORT

SECTION 1: LOCATION INFORMATION *(cont.)*

REF. LINE #	DATE	COUNTY	ROUTE	LOCATION MILE POINT	SIDE SPRAYED	WEATHER CONDITIONS	ACTIVITY USED	TARGET SPECIES
6.								
7.								
8.								
9.								
10.								

SECTION 2: PESTICIDE APPLICATION RECORD *(cont.)*

REF. LINE #	RATE OF CARRIER	SPRAYER #/APP NAME/CERT #	NAME OF PESTICIDE/ACRE	GALLONS OF SOLUTION/ROUTE	TOTAL PESTICIDE USED/ROUTE
11.			Choose an item.	_____/_____	_____/_____
12.			Choose an item.	_____/_____	_____/_____
13.			Choose an item.	_____/_____	_____/_____
14.			Choose an item.	_____/_____	_____/_____
15.			Choose an item.	_____/_____	_____/_____

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	Vegetation Control Under Guardrails and DGA Areas				
Herbicide	Roundup Custom or Rodeo		Roundup Custom /Esplanade/ Perspective	Roundup Custom /Endurance(Proclipse)/ Perspective	Roundup Custom /Oust Extra
Rate Per Acre	1.0 quart		32 ounces/ 4 ounces/ 8 ounces	32 ounces/ 2 pounds/ 8 ounces	32 ounces/ 2 ounces
Cost Per Acre	$5.00		$72.00	$62.00	$10.00
Time of Application	March 1- October 1		March 1- June 1	March 1- June 1	March 1- June 1
Type of Treatment	Foliar		Foliar & Soil	Foliar & Soil	Foliar & Soil
Rate of Carrier	25 gals. Water		50 gals. Water	50 gals. Water	50 gals. Water
Maximum Height of Vegetation	No Limit		No Limit	No Limit	No Limit
Special Features	Non-selective systemic activity. Wet all parts. No residual control.		Non-selective systemic activity. Full season control.	Non-selective systemic activity.	Non-selective systemic activity.
Precautions	Do not apply to desirable vegetation!				Avoid over-application to frozen soil, paved surfaces, high water, or during heavy rainfall.

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	Vegetation Control Under Guardrails Continued		Tall Fescue Seedhead Suppression		
Herbicide	Roundup Custom /Payload/ Polaris AC Complete	Rodeo /Endurance/ Polaris AC Complete	Stronghold	Plateau/ Perspective	Plateau/2,4-D Amine
Rate Per Acre	32 ounces/ 10 ounces/ 6 ounces	32 ounces/ 2 pounds/ 6 ounces	12 ounces	2 ounces/ 3.5 ounces	4 ounces/ 2 quarts
Cost Per Acre	$66.00	$32.00	$37.00	$18.00	$11.00
Time of Application	March 1-June 1	March 1-June 1	April 15-May 15	April 15-May 15	April 15-December 1
Type of Treatment	Foliar & Soil	Foliar	Foliar	Foliar	Foliar
Rate of Carrier	50 gals. Water	50 gals	50 gals	50 gals	50 gals
Maximum Height of Vegetation	No Limit	No Limit	6-12 inches	6-12 inches	6-12 inches
Special Features	Non-selective systemic activity.	Non-selective systemic activity.	Tall Fescue Seedhead Suppression	Systemic PGR	Systemic PGR
Precautions	Avoid over-application to frozen soil, paved surfaces, high water or during heavy rainfall.	Avoid over-application to frozen soil, paved surfaces, high water or during heavy rainfall.	Do not mow within 14 days after treatment.	Do not mow within 14 days after treatment.	Some yellowing of fescue will occur.

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	Vegetation Control Around Landscape Plants and Shrubs				
Herbicide	Roundup Custom or Rodeo	Endurance	Gallery	Pendulum Aquacap	Snapshot 2.5 TG
Rate Per Acre	1.0 quarts	2 pounds	0.5 ounces per 1000 square feet	3 ounces per 1000 sq.ft	2.5-3.5 pounds per 1000 square feet
Cost Per Acre	$5.00	$19.00	N/A	N/A	N/A
Time of Application	When vegetation is actively growing.	March 1-April 1	Before weeds emerge.	Before weeds emerge.	Before weeds emerge.
Type of Treatment	Foliage and Stem directed.	Soil applied	Soil applied	Soil applied	Soil applied granule
Rate of Carrier	25 gals. Water	50 gals. Water	2 gals. per 1000 square feet	50-100 gals. Water	2 gals. per 1000 square feet
Maximum Height of Vegetation	No Limit	Bare soil	Bare soil	Bare soil	Bare soil
Special Features	Non-selective systemic	Selective Pre-Emergent	Pre-emergence	Pre-emergence	Pre-emergence
Precautions	Avoid applying onto desirable vegetation.	Higher rates may damage plants.	Higher rates may damage plants.	Higher rates may damage plants.	Higher rates may damage plants.

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	Post-Emergence Grass Control in Shrub Beds		Wildflower Establishment & Maintenance		Tall Fescue Control
Herbicide	Envoy Plus	Acclaim Extra/ Fusilade II	Plateau	Rodeo /2,4-D Tank Mix	Plateau
Rate Per Acre	16 ounces	7 ounces/ 14 ounces	4 ounces	32 ounces/ 2 quarts	12 ounces
Cost Per Acre	N/A	$45.00	$3.00	$11.00	$12.00
Time of Application	Before grass reaches 12 inches tall.	Before grass reaches 24 inches tall.	When vegetation is actively growing.	When vegetation is actively growing.	When vegetation is actively growing.
Type of Treatment	Foliar	Foliar	Foliar	Foliar	Foliar
Rate of Carrier	25 gals. Water	25 gals. Water	26 gals. Water	27 gals. Water	25 gals.
Maximum Height of Vegetation	12 inches	36 inches	None	None	None
Special Features	Selective systemic	Selective systemic	Controls Crabgrass and Foxtail. Some wildflowers may be injured.	Non-selective, systemic activity.	Selective systemic
Precautions	Ornamental beds only. Not labeled for wildflowers.	Ornamental beds only. Not labeled for wildflowers.	Refer to label for tolerant species.	Use to prepare wildflower sites for seeding.	Use to prepare native grass sites for seeding.

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	Aquatic Vegetation Control		Crown Vetch Establishment & Maintenance		Sidewalk Cracks
Herbicide	Polaris AC Complete	Rodeo	Plateau	Fusilade II	Rodeo/ Esplanade
Rate Per Acre	Use a 1% solution	Use a 1% solution	4 ounces-newly seeded, 8 ounces on established stands.	16 ounces	2% solution/ 3.6 ounces per 100 gal
Cost Per Acre	N/A	N/A	$4.00-$8.00	$23.00	N/A
Time of Application	When vegetation is actively growing.	When vegetation is actively growing.	Dec.-March	When vegetation is actively growing.	When vegetation is actively growing.
Type of Treatment	Foliar	Foliar	Foliar	Foliar	Foliar
Rate of Carrier	50 gals. Water	50 gals. Water	50 gals. Water	50 gals. Water	100 gals. water
Maximum Height of Vegetation	None	None	None	None	None
Special Features	Selective systemic	Selective systemic	Controls undesirable weeds.	Controls weedy grasses.	Selective systemic
Precautions	Use for Cattails, Phragmites and most aquatic weeds.	Use for Cattails, Phragmites and most aquatic weeds.	Some injury may occur.		Avoid applying onto desirable vegetation.

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	**Summer Weed Mixes**				
Herbicide	2,4-D Amine/MSMA/ Escort XP	Perspective	Garlon3A/Escort	2,4-D Amine or 2,4-D IVM Dry	Milestone VM/ Escort XP
Rate Per Acre	2 quarts/ 1/3 gallon/ 0.25 ounces	3 ounces	1/3 gallon/ 0.25 ounces	2 quarts or 36 ounces	7 ounces/ 1/3 ounce
Cost Per Acre	$18.00	$15.00	$15.00	$11.00	$18.00
Time of Application	April-June	April-June	April-June	April-June	April-June
Type of Treatment	Foliar Broadcast	Foliar Broadcast	Foliar Broadcast	Foliar Broadcast	Foliar Broadcast
Rate of Carrier	25-50 gals. Water	25-50 gals. Water	25-50 gals. Water	25-50 gals. Water	25-50 gals. Water
Maximum Height of Vegetation	30 inches	30 inches	30 inches	30 inches	30 inches
Special Features	Selective systemic for turf grass.	Selective systemic for turf grass.	Selective systemic for turf grass.	Selective systemic for turf grass.	Selective systemic for turf grass.
Precautions	Avoid Drift. **Always wear eye protection!**	Avoid Drift. **Always wear eye protection!**	Avoid Drift. **Always wear eye protection!**	Avoid Drift. **Always wear eye protection! Maximum of (2) two applications per year!**	Avoid application prior to high water or heavy rainfall.

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	Kudzu				
Herbicide	Streamline	Garlon 3A	Roundup Custom		
Rate Per Acre	11.5 ounces	1.5 gallons	1.0 gallon		
Cost Per Acre	$62.00	$62.00	$18.45		
Time of Application	June-October	June-October	June-October		
Type of Treatment	Foliar	Foliar	Foliar		
Rate of Carrier	100 gals. Water	100 gals. Water	100 gals. Water		
Maximum Height of Vegetation	No Limit	No Limit	No Limit		
Special Features	Systemic	Systemic	Systemic		
Precautions	Avoid drift. Spray when actively growing. May require multiple treatments.	Avoid drift. Spray when actively growing. May require multiple treatments.	Avoid drift. Spray when actively growing. May require multiple treatments.		

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	Nodding Thistle		Canada Thistle		
Herbicide	2,4-D Amine / Telar Tank Mix	Milestone	Transline/ Telar Tank Mix	Perspective	Overdrive
Rate Per Acre	2 quarts/ 0.25 ounces	5 ounces	1 pint/ 1 ounce	5 ounces	8 ounces
Cost Per Acre	$11.00	$12.00	$32.00	$23.00	$15.00
Time of Application	When vegetation is in full leaf.	When vegetation is in full leaf.	June 1 - November 1	When vegetation is in full leaf.	When vegetation is in full leaf.
Type of Treatment	Foliar	Foliar	Foliar	Foliar	Foliar
Rate of Carrier	25-50 gals. Water	25-50 gals. Water	25-50 gals. Water	25-50 gals. Water	50 gals. Water
Maximum Height of Vegetation	No Limit	No Limit	No Limit	No Limit	No Limit
Special Features	Selective systemic for turf grass.	Selective systemic for turf grass plus soil residual.	Selective systemic and root uptake.	Selective systemic foliage.	Selective systemic.
Precautions	Avoid over-application. Damage to turf may occur. Eye protection always required.	Avoid over-application. Use 7.0 ounce rate for Canada Thistle and Teasel.	Avoid over-application. Damage to turf may occur.	Avoid drift and application to desirable plants.	Avoid drift and application to desirable plants.

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	Johnsongrass			Jap. Bamboo	Stump Treatmnt
Herbicide	Outrider	Fusilade 2/ Acclaim Extra	MSMA	Polaris AC Complete	Garlon 4/Stalker/ Basal Oil Blend
Rate Per Acre	1.0 ounce	14 ounces/ 7 ounces	1/3 gallon	32 ounces	Apply this ready-to-use product with a hand sprayer to cut stumps
Cost Per Acre	$13.00	$45.00	$7.00	$50.00	
Time of Application	When weed is actively growing.	When weed is actively growing.	When weed is actively growing.	When vegetation is in full leaf.	When temperature is above freezing.
Type of Treatment	Foliar	Foliar	Foliar	Foliar	Cut Stump
Rate of Carrier	25-50 gals. Water	25-50 gals. Water	25-50 gals. Water	50 gals. Water	Ready to use
Maximum Height of Vegetation	No Limit	No Limit	No Limit	No Limit	Large stumps may require a follow-up spraying with foliar herbicide.
Special Features	Selective systemic activity for Johnsongrass and broadleafs.	Selective systemic activity for Johnsongrass and foxtails.	Contact herbicide for annual grasses and broadleafs.	Selective systemic.	Selective systemic activity on brush.
Precautions	Fescue injury greater during drought. Do not Mow 14 days after treatment.	Tank mixes with 2,4-D may decrease broadleaf control.	J-Grass Suppression only. No hand application allowed.	Avoid over-application. Severe damage to turf may occur.	Avoid applying to desirable plants.

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	**Brush Control**				
Herbicide	Garlon3A /Escort XP	Krenite-S/Polaris AC Complete	Opensight	Viewpoint	Dormant Premix
Rate Per Acre	2.0 quarts/ 2.0 ounces	2.0 gallons/ 12 ounces	3.3 ounces	18 ounces	6 gallons
Cost Per Acre	$23.00	$135.00	$17.00	$66.00	$150.00
Time of Application	July 15- Setember 15	July 15- Setember 15	July 15- Setember 15	July 15- Setember 15	December-March
Type of Treatment	Foliar	Foliar	Foliar	Foliar	Dormant Stem
Rate of Carrier	100 gals. Water	100 gals. Water	100 gals. Water	100 gals. Water	100 gals. Water
Maximum Height of Vegetation	No Limit	No Limit	No Limit	No Limit	20 Feet
Special Features	Selective systemic activity on brush.	Selective systemic activity on brush. Use on Redbud, Boxelder and other resistant brush.	Selective systemic activity on brush.	Selective systemic activity on brush.	Selective systemic activity on brush.
Precautions	Avoid drift on desirable vegetation.	Damage to adjacent turf is likely.	Avoid drift onto desirable vegetation.	Damage to adjacent turf is likely.	Complete coverage of stems required for control.

Kentucky Department of Highways Pesticide Program Chart

Classification of Treatment	**Adjuvants**				
Type of Adjuvant	Defoamer	Anti-Drift	90/10 Surfactant	Crop Oil	Nu-Film
Rate of Product	1 - 6 ounces per 100 gallons as needed.	1 - 5 quarts per 100 gallons as needed.	1 quart per 100 gallons of spray solution.	1 quart per 100 gallons of spray solution.	1/2 to 1 pint per acre
Mixing Sequence	Add to tank when over half full.	Add to tank after filling and adding the herbicide.	Add to tank after filling and adding the herbicide.	Add to tank after filling and adding the herbicide.	Add to tank while filling, before herbicides.
Precautions	Always use with mixes containing glyphosate and Krenite-S.	High rates may plug nozzles.	Refer to herbicide label for specific rates.	Refer to herbicide label for specific rates.	Use agitation. Do not leave mixes in tank overnight.

TRIPLE-RINSE PROCEDURE

1. Drain the container into the spray tank. Hold in vertical position for at least 30 seconds.
2. Add water (or other recommended diluents) until the container is about one-fourth full. Close the container.
3. Shake or roll the container to rinse all interior areas; then drain the rinsate into the spray tank. Be careful not to splash yourself.
4. Repeat the rinse and drain steps two more times.
5. Puncture plastic or metal triple-rinsed containers to prevent reuse.
6. Crush the container to reduce volume.

NOTE: Do not puncture or crush drums intended for reconditioning.

PRESSURE-RINSE PROCEDURE

1. Place empty container (metal or plastic) in a vertical position to drain into the spray tank.
2. Thrust the nozzle of the pressure rinser through the bottom of the empty container.
3. Rinse for at least 30 seconds.
4. Crush to reduce volume.

NOTE: Larger drums can be pressure rinsed by using commercially available probe systems.

PAT-3

COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

SPRAYER NOZZLES: Selection and Calibration

Prepared by Monte P. Johnson, Entomology, and Larry D. Suetnam, Agricultural Engineering

The proper selection of a nozzle type and size is essential for proper pesticide application. This publication covers nozzle description, recommended uses, selection of the proper nozzle type, and the "ounce" calibration method. A listing of nozzle manufacturers also is included.

The proper selection of a nozzle type and size is essential for proper pesticide application. The nozzle is a major factor in determining the amount of spray applied to an area, the uniformity of application, the coverage obtained on the target surface, and the amount of potential drift.

Nozzles break the liquid into droplets, form the spray pattern, and propel the droplets in the proper direction. Nozzles determine the amount of spray volume at a given operating pressure, travel speed, and spacing. Drift can be minimized by selecting nozzles that produce the largest droplet size while providing adequate coverage at the intended application rate and pressure.

Minimizing drift is especially important for herbicides.

Nozzle Description

Nozzle types commonly used in low-pressure agricultural sprayers include flat-fan, flood, raindrop, hollow-cone, full-cone, and others. Special features, or subtypes such as "extended range," are available for some nozzle types.

Flat-fan

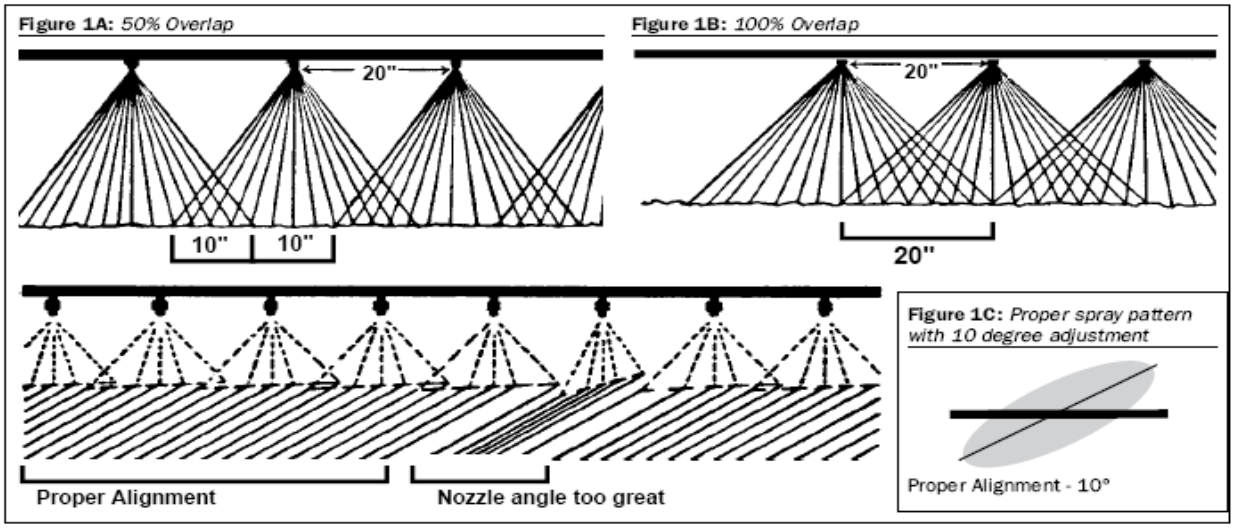
Flat-fan nozzles are widely used for broadcast spraying of herbicides. These nozzles produce a tapered-edge, flat-fan spray pattern (Figure 2A). These nozzles have several subtypes, such as standard flat-fan, even flat-fan, low pressure flat-fan, extended-range flat-fan, and some special types such as off-center flat-fans and twin-orifice flat-fans.

The **standard flat-fan** normally operates between 30 and 60 pounds per square inch (psi), with an ideal range between 30 and 40 psi.

The **even flat-fan** nozzles (Figure 2B) apply uniform coverage across the entire width of the spray pattern. They are used for banding pesticide over the row and should not be used for broadcast applications. The band width can be controlled with the nozzle height and the spray angle.

The **low pressure flat-fan** develops a normal flat-fan angle and spray pattern at operating pressures between 15 and 20 psi. Lower pressures result in larger droplets and less drift, but a low-pressure nozzle produces a smaller droplet at the same pressure as a standard nozzle.

The **extended range flat-fan** (Figure 2C) provides excellent drift control when operated between 15 and 25 psi. This nozzle is ideal for an applicator who likes the



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uniform distribution of a flat-fan nozzle and wants lower operating pressures for drift control. Since extended range nozzles have an excellent spray distribution over a wide range of pressures (15-60 psi), they are ideal for sprayers equipped with flow controllers.

The special feature flat-fan nozzle, such as the **off-center flat-fan,** is used for boom end nozzles so a wide swath projection is obtained. The **twin-orifice flat-fan** (Figure 2D) produces two spray patterns — one angled 30 degrees forward, and the other directed 30 degrees backward. The droplets are small due to the atomizing by two smaller orifices. The two spray directions and smaller droplets improve coverage and penetration, a plus when applying postemergence contact herbicides. To produce fine droplets, the twin-orifice usually operates between 30 and 60 psi.

Flat-fan nozzles are available in several spray angles. The most common spray angles are 65, 73, 80, and 110 degrees. Recommended nozzle heights for flat-fan nozzles during broadcast application are given in Table I. Figures 1A and 1B illustrate two spray overlap percentages. Figure 1C illustrates proper spray pattern. The spray pattern will be uneven if nozzles are not aligned properly on the spray boom. Rotate nozzles about ten degrees from the axis of the boom to prevent droplets from adjacent nozzles from touching but still allow for proper overlap of the spray pattern.

The correct nozzle height is measured from the nozzle to the target, which may be the top of the ground, growing canopy, or stubble. Use 110-degree nozzles when booms are at lower heights and 80-degree nozzles when booms are higher.

Although wide-angle nozzles produce smaller droplets that are more prone to drift, the reduction of boom height reduces the drift potential more than droplet size. The nozzle spacing and orientation should provide for 100 percent overlap and target height. Nozzles should not be oriented more than 30 degrees from vertical.

The following are examples of nozzle numbering systems by two manufacturers. Spraying Systems Company* identifies its flat-fan nozzles with a four or five digit number. The first numbers are the spray angle, and the other numbers signify the discharge rate at rated pressure. For example, an 8005 has an 80-degree spray angle and will apply 0.5 gallons per minute (GPM) at rated pressure of 40 psi. An 11002 nozzle has a 110-degree spray angle and will apply 0.2 GPM at rated pressure of 40 psi. Additional designations are "SS" (stainless steel), "HSS" (hardened stainless steel), and "VS" (color-coded stainless steel).

Delevan* flat-fan nozzles are identified by "LF" or "LF-R," which reflect the standard and extended range flat-fan nozzles. The first numbers are the spray angle followed by a dash and then the discharge rate at rated pressure. For example, an LF80-5R is an extended range nozzle with an 80-degree spray angle and will apply 0.5 GPM at the rated pressure of 40 psi.

Flood

Flood nozzles (Figure 2E) are popular for applying suspension fertilizers where clogging is a potential problem. These nozzles produce large droplets at pressures of 10 to 25 psi. The nozzles should be spaced less than 60 inches apart. The nozzle orientation should be set for 100 percent overlap. These nozzles are generally not suited for contact herbicide applications.

Table 1. *Suggested minimum spray heights*

	Spray Height (inches)			
	20" spacing		30" spacing	
	overlap		overlap	
Spray Angle Degrees	30%	100%	30%	100%
65	22-24	NR	NR	NR
73	20-22	NR	29-31	NR
80	17-19	26-28	26-28	NR
110	10-12	15-17	14-18	25-27

NR-Not recommended if height is above 30 inches.

Nozzle spacing between 30 and 40 inches produces the best spray patterns. Pressure influences spray patterns of flooding nozzles more than flat-fan nozzles. However, the spray pattern is not as uniform as with the flat-fan nozzles, and special attention to nozzle orientation and correct overlap is critical. Other than fertilizer suspensions, these nozzles are most often used with soil-incorporated herbicides with spray kits mounted on tillage implements.

Flooding nozzles are designated "TK" by Spraying Systems and "D" by Delavan. The value following the letters is the flow rate times 10 at rated pressure of 10 psi. For example, TK-SS2 or D-2 are flood nozzles that apply 0.2 GPM at 10 psi.

Raindrop

Raindrop nozzles produce large drops in a hollow-cone pattern at pressures from 20 to 50 psi. The "RA" Raindrop nozzles are used for herbicide incorporation and are usually mounted on tillage implements. When used for broadcast application, nozzles should be oriented 30 degrees from the horizontal. The spray patterns should be overlapped 100 percent to obtain uniform distribution. These nozzles are not satisfactory for postemergence or non-incorporated herbicides because the droplet size is too large.

Hollow-cone

Hollow-cone nozzles (Figure 2F) generally are used to apply insecticides or fungicides to field crops when foliage penetration and complete coverage of the leaf surface is required. These nozzles operate in a pressure range from 40 to 100 psi. Spray drift potential is higher from hollow-cone nozzles than from other nozzles due to the small droplets produced. Generally, this type of nozzle should not be used to apply herbicides.

Full-cone

The wide-angle, full-cone nozzles are a good choice if drift is a concern because they produce larger droplets than flood nozzles. Full-cone nozzles (Figure 2G) usually are recommended over flood nozzles for soil-incorporated herbicides.

Full-cone nozzles operate between a pressure range of 15 to 40 psi and are ideal for sprayers equipped with flow controllers.

Relative droplet size for each spray tip is shown in patterns.

Figure 2A. *Flat-fan*

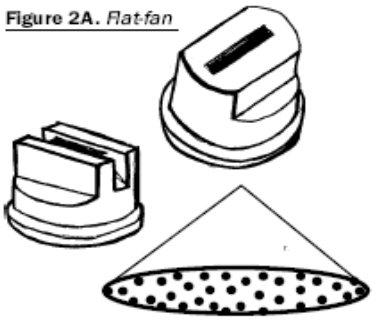


Figure 2B. *Even Flat-fan*

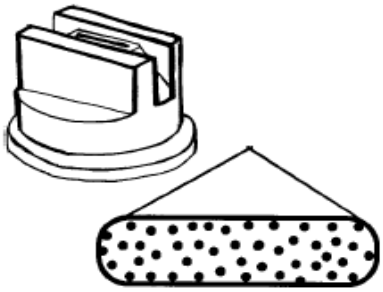


Figure 2C. *Extended Range Flat-fan*

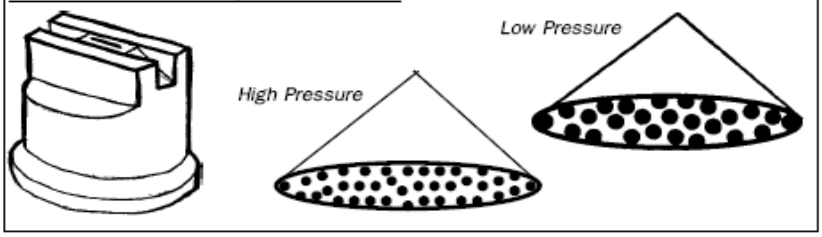


Figure 2D. *Twin-orifice Flat-fan*

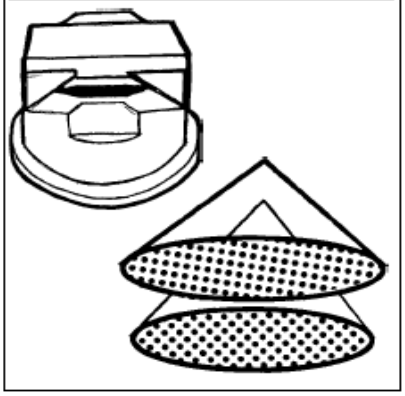


Figure 2E. *Flood*

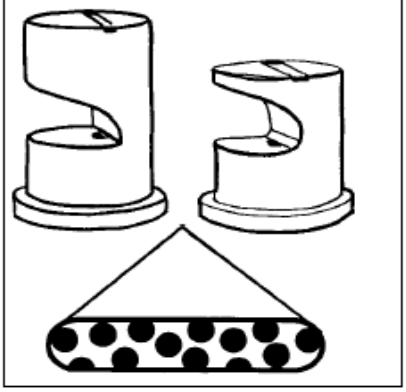


Figure 2F. *Hollow-cone*

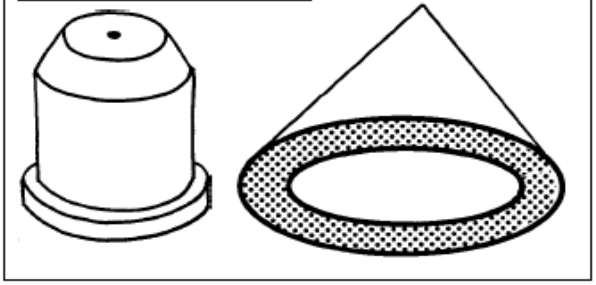
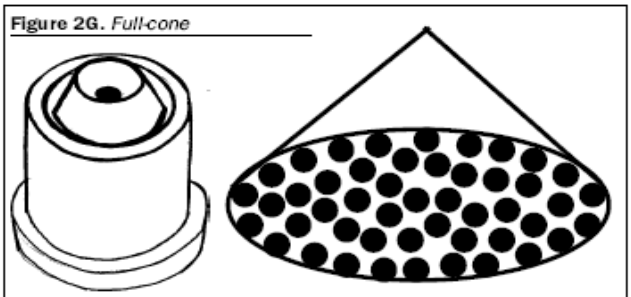


Figure 2G. *Full-cone*



Optimal uniformity is achieved by angling the nozzles 30 degrees and overlapping the spray coverage by 100 percent.

Fine Hollow-cone

The Cone-Jet (Spray Systems) and WRW-Whirl Rain (Delavan) are wide-angle (80-120 degrees), hollow-cone nozzles. These nozzles are used for postemergence contact herbicides where a finely atomized spray is used for complete coverage of plants or weeds.

Nozzle Materials

Nozzles can be made from several materials. The most common are brass, nylon, stainless steel, hardened stainless steel, tungsten carbide, and ceramic. Ceramic and tungsten carbide nozzles are very long-wearing and extremely corrosion-resistant. Stainless steel nozzles last longer than brass or nylon and generally produce a more uniform pattern over an extended time period. Nylon nozzles with stainless steel or hardened stainless steel inserts offer an alternative to solid stainless steel nozzles at a reduced cost. Thermoplastic nozzles have good abrasion resistance, but swelling can occur with some chemicals, and they are easily damaged when cleaned. Nozzles made from hard materials cost more initially, but in the long run, they pay for themselves because of long-lasting properties.

Do not mix nozzles of different materials, types, spray angles, or spray volumes on the same spray boom. A mixture of nozzles produces uneven spray distribution.

Nozzle Screens

To prevent plugging and excessive wear of the nozzles, always use screens (Figure 3) to remove large particles from the spray mixture, except when spraying very large volumes. At low rates, use 100-mesh screens. When using higher rates or applying wettable powders, use the 50-mesh size; check the manufacturer's recommendations for the specific nozzle. Smaller mesh screens may plug more easily and therefore require more frequent cleaning. Some screens have a ball check valve to prevent drip when the sprayer boom is turned off (Figure 4). These are useful if you stop in the field since excessive residues may damage the succeeding crop.

Another available anti-drip device is a diaphragm check valve (Figure 5). This valve allows the nozzle tip to be changed without letting spray material leak from the boom. Also, the diaphragm helps to protect the device from chemical corrosion which could cause a check valve to fail.

Nozzle Selection

It is important to select a nozzle that develops the desired spray pattern. The specific use of a nozzle, such as the broadcast application of herbicides or spraying of insecticides on row-crops, determines the type of nozzle needed. Examine current and future application requirements and be prepared to have several sets of nozzles for a variety of application needs. The steps below will help determine the correct nozzle type and capacity needed.

Step 1: Consult the Label. The most important source of information is the pesticide label. Not only will the label specify the application rates, controllable pests, and conditions needed to apply the pesticide, it often will provide information concerning the gallons per acre, nozzle type, and spacing. Follow the guidelines outlined by the pesticide label. If nozzle recommendations are not stated on the label, use Table II for selecting a type of nozzle to fit the application need.

Step 2: Select Operating Conditions. Select or measure ground speed in miles per hour (mph). If speed is unknown, follow the steps for calibrating a sprayer covered in this publication under *Sprayer Calibration With the "Ounce" Method* or in ID-98, *Guidelines for Pesticide Use*, or AGR-6, *Chemical Control of Weeds in Kentucky Farm Crops*. Select the desired nozzle spacing and spray volume. For most broadcast applications, 20-inch spacing is preferred. If these are not given on the pesticide label, follow Kentucky Cooperative Extension Service and chemical company recommendations.

Correct selection of spray volume is important. It will influence several spray characteristics such as drift potential, the spray coverage, droplet size, acres per tank, and pesticide effectiveness. As a rule of thumb, the greater the operating pressure or the greater the spray angle, the smaller the droplets become. Smaller droplets increase the drift potential. As the nozzle orifice becomes larger, the droplets increase in size.

Step 3: Calculate Required Nozzle Discharge. To select a specific orifice size, the spray volume, nozzle spacing, and travel speed are needed for the following calculation:

$$\text{Nozzle Discharge (GPM)} = \frac{\text{Travel Speed} \times \text{Nozzle Spacing} \times \text{Spray Volume}}{5940}$$

where:
Travel Speed = miles per hour (mph)
Nozzle Spacing = inches (in)
Spray Volume = gallons per acre (GPA)

Nozzle Selection and Sizing Example:

Suppose a postemergence herbicide is to be broadcast at 15 GPA at a speed of 5 mph. From Table II, the "BEST" choice was an extended-range flat-fan. The recommended nozzle spacing is 20 inches. Calculate the required nozzle discharge:

$$\text{Nozzle Discharge} = \frac{5 \text{ mph} \times 20 \text{ in} \times 15 \text{ GPA}}{5940} = 0.25 \text{ GPM}$$

The nozzle you select must have a flow discharge of 0.25 GPM when operated within the recommended pressure range from 15 to 60 psi (preferably under 40 psi). Nozzle

Figure 3. *Nozzle Screens*

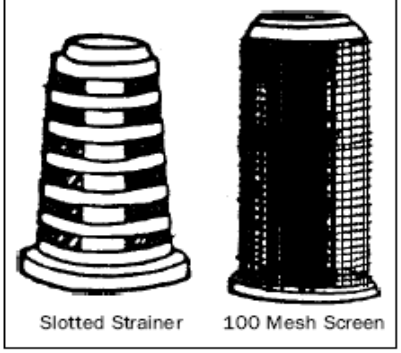


Figure 4. *Nozzle Screen with Check Valve*

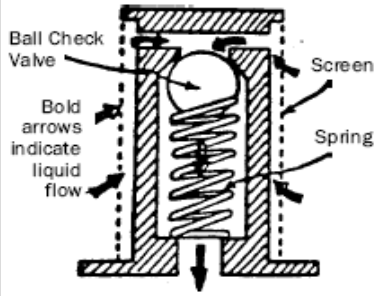
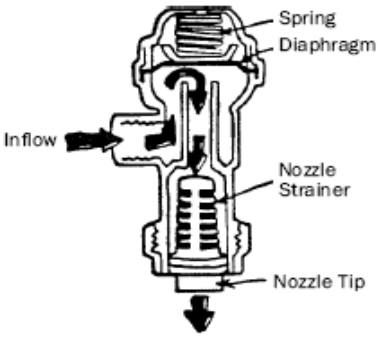


Figure 5. *Diaphragm Check Valve*



Figures 3 - 5 courtesy of the Northeast Regional Agricultural Engineering Service, Cornell University, Ithaca, N.Y.

performance tables in manufacturer's catalogs will show the discharge rates at various pressures for several nozzle sizes. Select the nozzle which will give you the most flexibility with a wide pressure range for "fine-tuning."

Step 4: Consult the Nozzle Catalog. Once the nozzle discharge (GPM) has been determined, consult the nozzle catalog for a specific nozzle number or size. Using the nozzle type selected from the application guide (Table II), review the specification of these nozzles in the discharge capacity column. Several consecutive nozzles may meet your need, but select a nozzle that operates at a low pressure and still gives a range for fine-tuning. Remember, most nozzles perform only over a limited pressure range.

A change in pressure does not cause an equal change in flow discharge. In some examples, in order to double the spray output, the pressure would have to be quadrupled. If you do not find the discharge rate in the catalogs, calculate the operating pressure using known catalog conditions:

$$psi_1 = psi_2 \times \left[\frac{GPM_1}{GPM_2}\right]^2$$

where:
subscript "1" is the desired condition and
subscript "2" is the known catalog condition

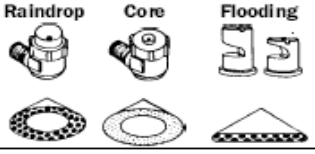
Example:
How much would the psi have to be increased to increase GPM from .26 to .40?

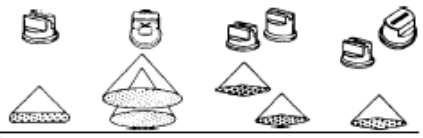
$$psi_1 = 30 \text{ psi} \times \left[\frac{.40 \text{ GPM}}{.26 \text{ GPM}}\right]^2 = 30 \text{ psi} \times 2{,}37 = 71 \text{ psi}$$

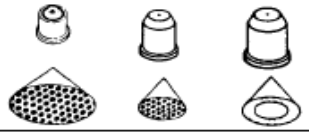
Although some nozzles such as cone types require high operating pressures, try to avoid pressures above 40 psi. Pressures over 40 psi increase the drift potential and put strain on the sprayer components. Conversely, avoid pressures less than the recommended minimum pressure because spray patterns begin to distort and cause poor spray uniformity.

Step 5: Calibrate the Sprayer. Once the nozzles are selected, purchased, installed, and flushed, calibrate the spray system. Nozzle catalogs provide tables to show spray volumes for various nozzles, spacing, pressures, and ground speeds. Use these tables to initially set up the sprayer, then use the "ounce" calibration method to evaluate and adjust the sprayer for accurate application.

Table II. *Nozzle Recomendations*

	Raindrop	Hollow-Core	Flooding
			
Pre-Emerge Herbicides			
Soil Incorporation	Good		Good
Band			
Broadcast	Good		Good
Post-Emerge Herbicides			
Contact-Band			
Contact-Broadcast		Good	
Systemic-Band			
Systemic-Broadcast	Good	Good	
Insecticide			
Band			
Broadcast			

	Even Flat-Fan	Twin Orifice Flat-Fan	Extended Range Flat-Fan	Standard Flat-Fan
				
Pre-Emerge Herbicides				
Soil Incorportion			Best	Better
Band	Best			
Broadcast		Good	Best	Better
Post-Emerge Herbicides				
Contact-Band	Best			
Contact-Broadcast		Better	Best	Better
Systemic-Band	Best			
Systemic-Broadcast			Best	Better
Insecticide				
Band	Best			
Broadcast		Good	Best	Better

	Full-Cone	Solid-Cone	Fine Hollow-Cone
			
Pre-Emerge Herbicides			
Soil Incorporation	Best		
Band		Good	
Broadcast			
Post-Emerge Herbicides			
Contact-Band		Good	Good
Contact-Broadcast			
Systemic-Band			Good
Systemic-Broadcast		Good	
Insecticide			
Band			Best
Broadcast		Good	

Sprayer Calibration with the "Ounce" Method

1. **Use the chart below** for distance to drive in the field. Use nozzle spacing for booms. For directed and band rigs, use the row spacing.
2. **Set throttle for spraying and operate all equipment**. Note seconds required to drive measured distance.
3. **Catch spray for the noted time in Step 2** in container marked in ounces (a calibrated bottle or measuring cup). If boom, catch spray from one nozzle during noted time. On directed rigs, catch spray from all nozzles per row for noted time.
4. **Nozzle or nozzle group output in ounces equals gallons per acre actually applied.**
5. **Repeat for each nozzle** to assure uniform distribution.

Row Width or Nozzle Spacing (IN)	Distance (FT)	Row Width or Nozzle Spacing (IN)	Distance (FT)
40	102	26	157
38	107	24	170
36	113	22	185
34	120	20	204
32	127	18	227
30	136	16	255
28	146	14	291

Replacing Nozzle Tips

Worn nozzles increase application rates and change distribution patterns. The result is poor pest control, crop damage, residue problems, and increased costs. A check of the boom sprayer assures that each tip is delivering an identical volume of spray in a smooth pattern with no heavy streams or blank areas. Should a nozzle become clogged, it is best to blow out the dirt with compressed air or use a soft-bristled brush such as a toothbrush. Wear waterproof gloves when handling and cleaning nozzles to reduce pesticide exposure. **NEVER** use a wire or nail as a cleaner because the orifice can be easily damaged. **NEVER** put tips in the mouth. Remember, improperly functioning or worn nozzles are costly.

Manufacturers of Nozzles

There are two principal manufacturers of spray nozzles and accessories. Local spray equipment dealers probably handle one or more of these lines. Each manufacturer distributes nozzle catalogs. These can be obtained from the local dealer or ordered at the following addresses:

Delavan-Delta, Inc.
20 Delavan Dr.
Lexington, TN 38351
800-621-9357

Spraying Systems Co. *(home office)*
North Avenue
P.O. Box 7900
Wheaton, IL 60189-7900

TeeJet Northeast *(branch office)*
P.O. Box 397
124A West Harrisburg St.
Dillsburg, PA 17019
717-432-7222

Other Kentucky Extension Publications

ID-98 *Guidelines for Pesticide Use*
ID-100 *Understanding Pesticide Labels and Labeling*
AGR-6 *Chemical Control of Weeds in Kentucky Farm Crops*
IP-13 *Protecting Kentucky's Groundwater: A Grower's Guide*

WEIGHTS & MEASURES CONVERSIONS

Weight
16 ounces = 1 pound = 453.6 grams
1 gallon water = 8.34 pounds = 3.78 liters

Liquid Measure
1 fluid ounce = 2 tablespoons = 29.57 milliliters
16 fluid ounces = 1 pint = 2 cups
8 pints = 4 quarts = 1 gallon

Length
3 feet = 1 yard = 91.44 centimeters
16.5 feet = 1 rod
5280 feet = 1 mile = 1.61 kilometers
320 rods = 1 mile

Area
9 square feet = 1 square yard
43,560 square feet = 1 acre = 160 square rods
1 acre = .405 hectare
640 acres = 1 square mile

Speed
88 feet per minute = 1 mph
1 mph = 1.61 kilometers per hour

Volume
27 cubic feet = 1 cubic yard
1 cubic foot = 1728 cubic inches = 7.48 gallons
1 gallon = 231 cubic inches
1 cubic foot = 0.028 cubic meters

Common Abbreviations and Terms Used:
GPM = gallons per minute
GPA = gallons per acre
psi = pounds per square inch
mph = miles per hour
RPM = revolutions per minute
GPH = gallons per hour
FPM = feet per minute

* Mention of trade and company names are included for the benefit of the reader and do not infer endorsement or preferential treatment of the product by the University of Kentucky Cooperative Extension Service.

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DANGER
PESTICIDE
STORAGE AREA

MATERIAL REFERENCE TOXICITY SHEET

Common Name	Active Ingredient	Oral LD50	Signal
2,4-D Formula 40	2,4-dichlorophenoxyacetic acid	866	Danger
2,4-D Dry	2,4-dichlorophenoxyacetic acid	2621	Danger
Acclaim Extra	Fenoxaprop-p-ethyl	>5000	Caution
BK 800	2,4-D, 2,4-DP, Dicamba	1141	Warning
Element 3A	Triclopyr	1900	Danger
Element 4	Triclopyr	1354	Caution
Escort XP	Metsulfuron Methyl	>5000	Caution
Esplanade 200SC	Indaziflam	>5000	Caution
Fusilade II	Fluazifop	>5000	Caution
Krenite S	Fosamine	>5000	Caution
Milestone VM	Aminopyralid	>5000	Caution
MSMA	MSMA	2833	Caution
Opensight	Aminopyralid + Metsulfuron	>5000	Warning
Oust Extra	Sulfometuron + Metsulfuron	>5000	Caution
Outrider	Sulfosulfuron	>5000	Caution
Overdrive	Diflufenzopyr + Dicamba	1600	Caution
Payload	Flumioxazin	>5000	Caution
Perspective	ACP + Chlorsulfuron	>5000	Caution
Plateau	Imazapic	>5000	Caution
Polaris AC Complete	Imazapyr	>5000	Caution
Rodeo	Glyphosate	>5000	Caution
Roundup Custom	Glyphosate	>5000	Caution
Streamline	ACP + Metsulfuron	>5000	Caution
Stronghold	Mefluidide + Imazethapyr + Imazapyr	>5000	Caution
Telar XP	Chlorsulfuron	>5000	Caution
Transline	Clopyralid	>5000	Caution
Viewpoint	ACP + Metsulfuron + Imazapyr	>5000	Caution

Toxicity Categories

Study	Category I	Category II	Category III	Category IV
Acute Oral	Up to and including 50 mg/kg	> 50 thru 500 mg/kg	> 500 thru 5000 mg/kg	> 5000 mg/kg
Acute Dermal	Up to and including 200 mg/kg	> 200 thru 2000 mg/kg	> 2000 thru 5000 mg/kg	> 5000 mg/kg
Acute Inhalation [1]	Up to and including 0.05 mg/liter	> 0.05 thru 0.5 mg/liter	> 0.5 thru 2 mg/liter	> 2 mg/liter
Primary Eye Irritation	Corrosive (irreversible destruction of ocular tissue) or corneal involvement or irritation persisting for more than 21 days	Corneal involvement or other eye irritation clearing in 8-21 days	Corneal involvement or other eye irritation clearing in 7 days or less	Minimal effects clearing in less than 24 hours
Primary Skin Irritation	Corrosive (tissue destruction into the dermis and/or scarring)	Severe irritation at 72 hours (severe erythema or edema)	Moderate irritation at 72 hours (moderate erythema)	Mild or slight irritation at 72 hours (no irritation or slight erythema)

[1] 4 hr exposure

SIGNAL WORDS ASSOCIATED WITH TOXICITY CATEGORIES

Toxicity Category I	DANGER
Toxicity Category II	WARNING
Toxicity Category III	CAUTION
Toxicity Category IV	None Required

TRANSPORTATION CABINET
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John Mucci
Mike Smith
Michael Williams

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TRANSPORTATION CABINET
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Somerset	Jeff Pettyjohn 1660 South Highway 27 Somerset, KY 42502 Ph: 606-677-4017
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Grainger Industrial Supply
800-323-0620
www.grainger.com

Gemplers
800-382-8473
www.gemplers.com

Ben Meadows
800-241-6401
www.benmeadows.com

Uline
800-295-5510
www.uline.com

Seeding and Fertilization Program Chart

(Recommended Seeding Rates)

NOTE: Rates may vary from District to District or as needs dictate.

Complete Seeding (Disking, fertilizing & mulch)		
Mixture:	Ky 31 Fescue	100 - 250 lbs/acre
	Perennial Ryegrass	10 - 15 lbs/acre
Alone:	Ky 31 Fescue	200-250 lbs/acre
Fertilizer:	19-19-19	350 - 550 lbs/acre
Straw:		2 tons/acre
Hydromulch:		500 - 1000 lbs/acre

No-Till Seeder		
Mixture:	Ky 31 Fescue	50 -75 lbs/acre
	Perennial Ryegrass	10 - 15 lbs/acre
Alone:	Ky 31 Fescue	75 - 100 lbs/acre
Fertilizer:	19-19-19	300 lbs/acre

Over Seeding (Hydroseeder)		
Mixture:	Ky 31 Fescue	75-100
	Perennial Ryegrass	10 -15 lbs/acre
Alone:	Ky 31 Fescue	100 - 150 lbs/acre
Fertilizer:	19-19-19	275 - 450 lbs/acre

Over Seeding (By hand or tractor)		
Mixture:	Ky 31 Fescue	75 -100 lbs/acre
	Perennial Ryegrass	10 - 15 lbs/acre
Alone:	Ky 31 Fescue	100 - 150 lbs/acre
Fertilizer:	19-19-19	450 lbs/acre

Seeding Under Guardrail		
Alone:	Hard Fescue	100-150 lbs/acre
Fertilizer:	19-19-19	300 lbs/acre

Fall Fertilizer Topdressing		
Fertilizer:	46-0-0	150 lbs/acre
(Mulch for protection. Do not apply when temperatures exceed 80 degrees)		
Fertilizer:	19-19-19	300 lbs/acre