Guide to Effective Weed Control

Howard A. L. Greer
Former Extension Weed Control Specialist

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http://osufacts.okstate.edu

Agricultural losses due to weeds in the United States have been estimated at 10 billion to 12 billion dollars per year. These weed losses do not include losses to homeowners, public parks and other recreation areas, right-of-ways, railroads, and other noncropland areas.

There are over 30,000 weed species throughout the world and over 4,800 of these cause significant economic losses in production of food, feed, and fiber.

In addition to these losses to agriculture, weeds can cause health problems to people and animals. Poison ivy on the skin or allergy problems from certain pollens are examples of common human health problems. Some plants are poisonous if consumed and pose danger to young children. Several plants are poisonous to livestock. Weeds also serve as host plants for certain insects and disease organisms and invade aquatic habitats.

Weeds can be controlled in many ways. Methods of control include mechanical methods, crop competition, crop rotation, biological predators and diseases, fire, and chemical control. Use of chemicals will be the main topic of discussion in this publication.

Herbicides are chemicals that are used to control vegetation. In most cropping situations, it is desirable to control the unwanted vegetation (weeds) and leave the desirable vegetation (crop). Some simple guidelines can be very helpful in using a herbicide for effective control without damage to the crop. Three main types of herbicides are used in crop production.

Contact herbicides kill primarily by contact with plant tissue. Two requirements for successful contact herbicide use are good plant coverage and an adequate rate (often based on the temperature on the day of application). Many labels on contact herbicide containers will suggest that the chemical be applied on a day when the temperature is above a certain minimum and a higher volume of water be used than would be required for most other herbicides.

Translocated herbicides that are foliage applied move through the entire plant system. These chemicals accumulate in and affect the active growth centers. In general, these compounds are selective. Some of them are effective in the soil and can be taken into the plant through the roots as well as through the plant foliage. Selectivity of foliage applied herbicides must depend primarily on biochemical or structural differences between plants or selective application.

Soil-applied herbicides are referred to as the residual herbicides. These chemicals may be taken up by the plant roots and translocated throughout the plant or the chemicals may have an effect on the development of the system. Many of these selective herbicides either affect the young shoot or root as it emerges from the seed, but will not control the plant after it begins to develop. This is the reason it is necessary with most herbicides to have the chemical applied and activated by rainfall before the weeds germinate. A few of the soil-applied herbicides, such as certain soil sterilants, may affect larger plants if adequate amounts are taken up.

Identify the Problem

The first necessary step in solving any weed problem is to identify the problem. To design an effective weed control program with herbicides, the weeds that are a problem must be identified. Each herbicide differs as to which plants it controls. There are frequently tremendous differences between control practices needed for annual weeds compared to perennials, between winter annuals and summer annuals, or between grassy weeds and broadleaf weeds.

Weeds can often be classified into plant groups such as families or genus. This type of classification can be very important, since weeds that are similar are often susceptible to the same herbicides.

A good time to identify summer weed problems is in late summer or fall when they are flowering or producing seeds. It is often too late to apply a treatment that year, but the problem can be identified, so that the appropriate herbicide can be used the next year. If you cannot identify the weed, take a sample of the plant to the county Extension office. If the agriculture educator does not know the plant, he/she will send it to someone at OSU for identification. Plant identification resources are also available online at the Noble Foundation Plant Image Gallery (www.noble.org/webapps/plantimagegallery/index.aspx), Kansas Wildflowers and Grasses (www.kswildflower.org), and the OSU Weed Science Extension website (www.weedscience.okstate.edu).

Herbicide — Plant Selectivity

The practical use of herbicides in weed control is based on the ability of the herbicides to kill some types of plants (weeds) without injury to desirable plants (crops). The term used for this phenomenon is selectivity. The degree to which plants react is a measure of their susceptibility to the herbicide. Tolerance is the negative response to the herbicide, that is,

the degree to which the plant fails to respond to the herbicide. Hopefully, some plants (weeds) will be susceptible to a particular herbicide resulting in severe damage or death and other plants (the crop) will have a tolerance for that particular herbicide. The difference between susceptibility and tolerance is often influenced by such things as the depth of seeding, stage of growth when the plants are treated, the herbicide concentration absorbed by the plants, the inherent toxicity of the herbicide, and factors such as moisture, temperature, application, and soil characteristics. Information on many of the factors that affect herbicide performance can be found in OSU Extension Fact Sheet PSS-2768, and information about the proper use of the herbicide for maximum performance can be obtained from studying the herbicide label.

Choosing the Herbicide Program

The choice of which herbicide or combination of herbicides to use depends on the crop, timing of chemical application, and the label requirements that may limit certain uses of the herbicides. Some herbicides have certain application requirements for maximum effectiveness, while others have certain soil and climatic restrictions.

Herbicides can be classified into three groups for crop use, based on timing of application with respect to the crop growth stage.

Preplant herbicides are applied before the crop is planted. In most cases, preplant herbicides are volatile and will escape if left on the soil surface. Therefore, they should be incorporated (mixed) with the soil immediately after application. Failure of proper incorporation is one of the most common causes of poor performance of these herbicides. Each herbicide label gives specific information about proper application and incorporation of that herbicide for maximum performance and minimum crop injury.

Preemergence herbicides are applied to the soil surface after planting the crop, but before the weeds and crop emerge. Rainfall or irrigation is required to take them into the top inch of soil before the weed seeds germinate. Many herbicides do not perform effectively if they are incorporated into the soil. Therefore, they should be left on top unless the label indicates otherwise.

It is very important to apply a preemergence herbicide to a weed free soil or in combination with a contact herbicide to kill weeds that have already emerged. If a preemergence herbicide is not activated by rainfall or irrigation before weeds emerge, it is necessary to cultivate or use a postemergence herbicide to kill existing weeds.

Postemergence herbicides are applied after the crop or weeds have emerged from the soil. Usually the term postemergence refers to applications made when both crop and weeds are growing. Sometimes a herbicide will be used postemergence for the crop and preemergence to weeds. Postemergence herbicides may be selective chemicals that are translocated from the foliage into the plant, or they may be selective contact herbicides. Postemergence herbicides must be applied in accurate doses, so that the amount taken into the crop plant will not be enough to cause injury.

Several herbicides that cannot be applied over the top of a crop can be used postemergence in a directed spray to the base of the crop plants. Directed type applications are more suited to tall crops such as soybeans, corn, grain sorghum, and cotton. If the first flush of weeds can be controlled with preplant or preemergence herbicides, the difference in height between the crop and the weeds will usually be adequate for directed applications. The spray should be directed to cover the weeds and only hit the base of the crop plants; therefore, tolerant crops will not be affected by the small amount of the chemical.

Conditions for use of postemergence herbicides are very critical in some cases. Maximum weed size, maximum temperature and optimum crop size for effective control and minimum injury will usually be described on the label.

Choosing the Formulation

Emulsion indicates the suspension of one liquid as minute droplets in another liquid. An example of this is oil dispersed in water. Many of the herbicides are formulated as emulsions. These liquid solutions can be emulsified into water for application. The manufacturer has dissolved the organic herbicide in an organic solvent with sufficient additives and emulsifiers to make an oil in water emulsion, which will mix well when they are put into the water as a carrier in the spray tank.

Wettable powders are finely ground particles of herbicide. When the herbicide is mixed with a liquid carrier such as water, it does not dissolve, but is suspended in the liquid. It must be kept suspended at all times for proper application. The powder is so finely ground that it will go through spray nozzles. Good agitation is a must with this type of formulation at all times to keep it mixed with the water. Information is available on the package describing the amount of carrier, size of nozzles, types of screens, and other instructions necessary for proper application.

Granular formulations are sometimes available for some herbicides. A granular formulation is a herbicide impregnated on small pieces of some type of inert material as a carrier. The inert material is not active as a herbicide in the environment. The herbicide is gradually released from the granules as they dissolve or disintegrate. A granular formulation is good in cases where the herbicide is very soluble and dissolves fast, or where it is desirable to have the herbicide bounce off the foliage of the crop and be taken up through the root system. Granular formulations are often used in lawns or in small areas where spraying is impractical. Granulars can be used in crops where a granular applicator is pulled behind the planter.

Some herbicides may be produced in several different formulations. For example, 2,4-D is sold in many different formulations, but basically these are either esters, salts, or granules.

Ester formulations are oil based and are much more effective in controlling plants during cool weather or when weeds have a waxy leaf. This formulation sticks on the plant leaves and is taken into the plant over a period of several days. However, when it is hot, the ester will volatilize and can be carried through the air to non-target areas. Injury can occur to plants outside the treated area because it volatilizes and drifts to the non-target area.

Amine salt formulations may be safer to the surrounding environment because they are not volatile. However, the amine salt is not effective as the ester for control of certain species of weeds that are somewhat tolerant to the herbicide. It usually is not as effective during cool weather or when applied to large weeds.

Persistence of Herbicides

Persistence of a chemical refers to how long it remains in the soil. The length of time it lasts may affect the efficiency for adequate season long weed control in a crop. Chemicals with a long persistence may affect the crop grown next year. In perennial crops such as alfalfa, it is desirable to have long lasting herbicides. On the other hand in a double crop system, it is desirable to have a less persistent herbicide, so that injury will not occur to the next crop. Some spring applied herbicides last long enough to injure fall seeded crops. The persistence in the soil for possible injury to the next crop and the persistence of the herbicide at levels that will control weeds in the presently planted crop are important considerations in choosing which herbicide to use in a crop.

Using the Herbicide

Next to proper herbicide selection, proper application is the most important part of a good weed control program. Some herbicides have specific application requirements for maximum effectiveness while others have different requirements or climatic restrictions. Consideration of soil type, climatic conditions, the crop, the weeds to be controlled, and the application equipment available will help a grower to determine what herbicide will best fit his particular cropping system.

Proper mixing of the herbicide with the carrier (usually water) is very important. Many herbicides will mix easily with water and adequate coverage can be obtained with 10 to 20 gallons of water per acre. However, there are other herbicides that require rather specific carrier volumes.

Some herbicides, such as paraquat that are used for contact activity, require a higher gallonage of water. If these herbicides are not used in adequate carrier to give excellent coverage of the weeds, poor kill can be expected.

Proper application is a must for effective herbicide performance. The majority of complaints about herbicide failure or injury to crops can be traced to either failure to use the right rate of herbicide for the particular soil type and crop or failure to follow application requirements for the herbicide. One of the first things to consider about a herbicide is what kind of application equipment is required to properly apply it. It is very important to get good even coverage of the herbicide on the soil surface or plant foliage. This means good spray equipment as well as proper calibration of the equipment. Fact Sheets are available on application equipment and proper calibration and use of sprayers. These are listed in the last section of this publication.

Follow-up practices are often needed for the most effective weed control program when using herbicides. Many producers who have little or no experience with herbicides assume that the use of a chemical will solve all the problems and nothing else will need to be done. Sometimes a herbicide fails to perform as expected due to climatic conditions or other factors that affect the chemicals. For example, there may be moisture in the soil to germinate a planted crop and to germinate many of the weed seeds that are in the soil, but rainfall may not occur to activate the herbicide. In this case, if the field is left with no attention following the preemergence application, a heavy weed population will develop. However, use of a rotary hoe or light cultivation to remove the early weeds while they are still small will often solve the problem. Moisture will probably be available before the next weeds germinate and a light incorporation will help to activate the herbicide.

In other cases, a weed species resistant to the herbicide that is used may produce seeds and increase in the field. If a few plants of a resistant species were present last year and produced seeds, there may be several this year. In this case, it may be necessary to follow up the preplant or preemergence treatment with a postemergence herbicide that will kill this weed species. Effective weed control usually involves a complete program, instead of use of just one herbicide.

Herbicide Injury

Sometimes injury will occur in a crop after herbicide use. If the injury is due to the herbicide, not much can be done except to decide whether to replant or wait to see if the crop recovers. Good growth conditions such as nitrogen application or irrigation may also help.

Many problems have been attributed to herbicides that are actually caused by disease, insects, nematodes, fungi, nutrient deficiencies, drought stress, poor seed quality, and other causes. If a herbicide program is a new practice for a grower, he/she often assumes that the problem is associated with the herbicide. Investigate all the possibilities. Pull up plants and look at the root system. Take a good look at the leaves with a magnifying glass to determine if there are any insects or mites infesting the plant. After a thorough investigation of patterns in the field and possibilities that can be seen with the eye, if you are not sure what the problem is, call the county Extension office for ideas.

Herbicide Failures

Sometimes a herbicide will fail to control all the weed problems in the field. This again calls for investigation of the problem. Check to determine if you used the right herbicide and the right amount for the number of acres that were treated. Be sure to identify the weed problems in the field. Sometimes a field can have a weed problem that looks like a failure of the herbicide, but under close investigation, it is discovered that there is only one weed species remaining in the field. This may be a weed that is tolerant or resistant to the particular herbicide program used. Do the investigation in time to use an alternative method of control, such as cultivation or another herbicide. Herbicides usually do not fail in the job they are designed to do, but sometimes conditions fail the herbicide.

Publications

"Weed Identification Guide"
Southern Weed Science Society

OSU Extension Fact Sheets:

BAE-1215 Selecting the Proper Nozzle Type and Size for Low Pressure Ground Sprayers
BAE-1216 Calibrating a Low Pressure Ground Sprayer
BAE-1217 The Low Pressure Ground Sprayer
BAE-1218 Pumps For Low Pressure Ground Sprayers
EPP-7457 Toxicity of Pesticides

In addition to the above publications, there are fact sheets available in county Extension offices on weed control in each major crop grown in Oklahoma and specific fact sheets on major weed problems, such as bindweed or johnsongrass.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Robert E. Whitson, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 20 cents per copy. 1009 Revised GH.

PSS-2750-4