



WEED CONTROL IN WHEAT

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Weeds may affect wheat production in many ways. Wheat yield may be reduced significantly when weeds compete with wheat plants for light, water, and minerals. Weeds may also inhibit wheat growth through release of allelopathic chemicals that are toxic to wheat plants. Weeds or weed seeds contaminating harvested grain may reduce quality. In addition, weeds may interfere with harvesting or raise the moisture content of the harvested grain, leading to damage from heat and pests in storage.

In the relatively mild and wet climate of western Washington, the primary weeds in wheat are annual broadleaf weeds that germinate just before or as the wheat germinates. Wheat, whether seeded in the fall or spring, frequently becomes a solid mat of well established broadleaf annual weeds if weed control practices are lacking. However, some areas are also plagued by grasses: annual ryegrass, wild oats, and quackgrass. Perennial weeds may also be troublesome in either crop.

An integrated weed management system that combines cultural and chemical weed management practices is the most effective and economical way to manage weeds in wheat. Although several effective herbicides are available to control broadleaf weeds and grasses in wheat, herbicides should be viewed as an additional tool, not as a remedy. Often, when one control method, whether chemical or mechanical, is used continuously, a shift in the weed population toward a difficult-to-control species will occur. Herbicide resistant plants within a species can be selected from a susceptible species and can increase in number. Most commonly, tolerant species can replace sensitive ones that have been eliminated by herbicides. This problem can be avoided by integrating as many control measures as possible such as crop rotation, using mixtures of herbicides with different modes of action, and by rotating herbicides from one season to the next.

CULTURAL PRACTICES

Seedbed Preparation

A properly prepared seedbed can significantly reduce weed infestation. If possible, germinate the first flush of weeds before beginning tillage operations using rainfall or irrigation. Plow as deeply as possible to break up soil compaction and reduce risk of herbicide carryover if wheat is planted after vegetable seed crops, ornamental bulbs, corn, and other crops. The final tillage should be just before planting wheat so that

any germinated weeds do not have a competitive advantage.

Good field sanitation is essential for weed control. When possible select fields free from hard-to-control weeds. Clean planting, harvesting, and tillage implements prior to entering a field to eliminate introducing new weeds. Keep field perimeters weed free because they serve as an initial reservoir for seed to infest the field.

Clean Seed

Planting wheat seed contaminated with weeds is one of the most common ways to introduce weeds into wheat fields. Plant certified wheat seed. Certified seed is slightly higher priced, but it is cheap compared with managing a weed problem that can result from seed contaminated with weeds.

Crop Rotation

Weed infestations can be reduced by rotating to crops with a different life cycle or ones in which different cultural and chemical practices are used. Crop rotation regularly changes the crop in each field, the soil preparation practices in that field, subsequent tillage, and weed-control techniques. All these factors affect weed populations. Rotating wheat with summer crops is a very logical weed control practice. Summer crops such as green peas, vegetable seed, and cucumber benefit when planted following wheat. Unlike broadleaf weeds, annual grasses in soils are largely depleted after two to three years of summer cropping.

Crop Competition

Management practices which encourage a healthy and vigorous wheat crop will reduce losses from weeds. Some of these practices may include: seeding at the proper depth; seeding at the appropriate rate and time; selecting the correct amount, timing, and placement of fertilizers; using adapted cultivars; and controlling insects and diseases.

CHEMICAL CONTROL

Weed management is not accomplished by using cultural practices exclusively. Some weeds are favored by the same management practices that favor wheat. Herbicides offer an additional tool to control weeds in conjunction with cultural practices, but are not intended as a replacement for proper management practices.

The success of a herbicide application is dependent upon weed species, the timeliness and thoroughness of application, conditions at the time of application, herbicide rate, and crop management after the application. If the decision is to use a herbicide, carefully read the label. Following the label will reduce the likelihood of crop injury, reduce off-target movement of herbicide, and maximize weed control.

BROADLEAF WEED CONTROL

A number of herbicides are registered for broadleaf weed control in wheat. However, only six of these herbicides are effective for controlling weeds in wheat in western Washington. These herbicides are: 2,4-D, MCPA, dicamba (trade name Banvel), bromoxynil (Buctril), clopyralid (Stinger), and thifensulfuron + tribenuron (Harmony Extra).

The appropriate timing of the herbicides for the control of broadleaf weeds is illustrated in Figure 1. The sensitivity of broadleaf weed species commonly found in

wheat to herbicides is shown in Table 1.

2,4-D

Apply 0.125 to 1.0 pound acid equivalent per acre when wheat is fully tillered but before the elongation of stems. The herbicide may also be applied after the soft dough stage of growth to control weeds that interfere with harvest. Weed competition will have already done its damage to crop yields by this time, so this treatment is not generally recommended except to suppress some broadleaved perennials or as a harvest aid.

Precautions:

1	Do not apply 2,4-D before tillering stage or from stem elongation through soft dough stage. Application of 2,4-D during the jointing stage through powering may injure the developing heads and seriously reduce wheat yields.
2	Do not graze or feed forage within 2 weeks after 2,4-D treatment.
3	Do not apply to wheat underseeded to legumes.
4	Best weed control will be obtained when application is made under warm (55° to 85°F) and sunny conditions. However, at low temperatures, 2,4-D will control weeds to the same extent as at warmer temperatures but at a slower rate

MCPA

Apply 0.25 to 1.0 pound acid equivalent per acre in the spring when wheat is fully tillered but prior to stem elongation. MCPA provides more safety to wheat than 2,4-D and is more effective on a few broadleaf weeds such as creeping buttercup and red deadnettle. However, it is less effective than 2,4-D on most broadleaf weeds and is more expensive. MCPA may be applied earlier than 2,4-D. Follow the same instructions and precautions as in 2,4-D when you use MCPA.

Dicamba (Banvel)

Use 0.125 (spring wheat) or 0.25 (winter wheat) pound acid equivalent per acre prior to jointing stage in winter wheat and before wheat exceeds the 5-leaf stage in spring wheat. For best results, make application when weeds are in the 2- to-3 leaf stage and rosettes are less than 2 inches across.

Dicamba is more effective than 2,4-D or MCPA on certain weeds, such as wild buckwheat, chickweed, ladythumb, knotweed, mayweed chamomile, and pineappleweed. However, dicamba is less effective than 2,4-D or MCPA on mustards, shepherdspurse, bitter cress, wild radish, and buckhorn plantain. Therefore, 2,4-D or MCPA are frequently tankmixed with dicamba or prepackaged and sold under several trade names.

Precautions:

1	Surfactants are not recommended when applying dicamba alone or in tank mixtures, except with tribenuron (Express) or thifensulfuron + tribenuron (Harmony Extra).
2	Do not graze treated areas or harvest for livestock feed prior to maturity.
3	Do not apply to wheat fields underseeded to legumes.

Bromoxynil (Buctril)

Apply 0.25 to 0.375 (spring wheat) or 0.5 (winter wheat) pound active ingredient per acre when weeds have germinated but have less than 4 leaves or are 2 inches tall, whichever comes first. Wheat has good tolerance to bromoxynil from emergence to boot stage.

Bromoxynil is effective against many small annual broadleaves. It also controls certain 2,4-D tolerant broadleaf weeds in wheat such as Puddleneck, mayweed chamomile, pineappleweed, speedwell, and wild buckwheat. It is primarily a contact herbicide and therefore is not effective against large weeds and perennials. Thorough coverage of the weed seedlings is essential for optimum control. Bromoxynil can be used safely on seedling wheat when 2,4-D, MCPA, and dicamba should not be used.

Bromoxynil may cause transitory leaf burn. Because it is not systemic, recovery of the crop is generally rapid with no lasting effect. Frequency and amount of leaf burn may be greater when crops are stressed by abrasive winds, cool to cold evening temperatures, or mechanical injury resulting from hail, sleet, or insects. To reduce the potential for temporary leaf burn, application should be made to dry foliage when weather conditions are not extreme.

Precautions:

1	Do not graze treated fields within 30 days following treatment.
2	Do not apply when crop canopy covers the weeds as poor weed control will result.
3	Reduced weed control may occur when weeds are stressed by lack of moisture or cold temperatures.

Clopyralid (Stinger)

Apply 0.094 to 0.125 pound acid equivalent per acre when wheat is at the 3-leaf stage up to early boot stage of growth and weeds are at 1- to 5-leaf stage. For the control of Canada thistle, use this herbicide when weeds are at rosette to prebud stage. This herbicide will control some broadleaf weeds in wheat not readily controlled by 2,4-D or MCPA, such as wild buckwheat, mayweed chamomile, bull thistle, Canada thistle, Puddleneck, and pineappleweed.

This herbicide has long residual activity in the soil; therefore, do not plant alfalfa, asparagus, canola, cole crops, dry bean, onion, popcorn, safflower, sweet corn, or strawberry for 12 months after clopyralid application. In addition, do not plant peas, potatoes, and broadleaf crops grown for seed for 18 months after treatment, unless the risk of injury is acceptable.

2,4-D is combined with clopyralid and sold under the trade name Curtail. Consult the label for instructions on the use of this product.

Precautions:

1	Follow label instructions carefully regarding rotational restrictions for other crops.
2	Do not apply by aircraft.
3	Do not move treated soil and avoid situations where soil particles may blow into areas where susceptible crops are grown.
	Straw from treated areas, or manure from animals that have grazed

- 4 treated areas, cannot be used for composting or mulching on ground where susceptible crops may be grown the following season.

Thifensulfuron + tribenuron (Harmony Extra)

Apply 0.23 to 0.45 ounce active ingredient per acre when wheat is larger than the 2-leaf stage but before third node is detectable in winter wheat or Prst node is detectable in spring wheat. The use rates depend on the weed spectrum and size of the weeds at time of application.

Best results will be attained when weeds are young and actively growing. For optimum performance apply when conditions include temperatures of 60°F or higher and adequate soil moisture before, during, and immediately after treatment. This herbicide stops growth of susceptible weeds rapidly. However, typical symptoms on weeds (discoloration) may not be noticeable for 1 to 3 weeks after application, depending on environmental conditions and weed susceptibility. Warm, moist conditions following treatment promote herbicide activity on weeds, while cold, dry conditions delay activity.

This herbicide has very little or no soil activity, so only those weeds that have emerged will be controlled. Consequently, application of this herbicide should be made when all or the majority of weeds have emerged. Annual broadleaf weeds should be past the cotyledon stage, actively growing, and less than 4 inches tall or across.

Precautions:

1	Immediately after spraying, thoroughly clean herbicide from mixing and spray equipment.
2	Weeds hardened-off by cold weather or drought stress will be less susceptible to this treatment.
3	Do not plant any crop other than wheat or barley for 60 days after application.

ANNUAL GRASS CONTROL

Several herbicides have been developed primarily for the control of wild oats in wheat. These include triallate (Far-Go), difenzoquat (Avenge), and diclofop (Hoelon). Imazamethabenz (Assert) is another wild oat herbicide; however, it is not used in western Washington because of the long soil carry-over. Some of these herbicides are also effective against other grasses. For example, diclofop is highly active against Italian ryegrass, foxtail, and barnyardgrass. The susceptibility of grass weeds to herbicides is shown in Table 2. The appropriate time of applications of these materials for wild oats is illustrated in Figure 2 by wild oat leaf stage.

Triallate (Far-Go)

Apply 1.0 pound active ingredient per acre on spring wheat and 1.25 to 1.5 pounds per acre on winter wheat. In winter wheat apply the triallate before or immediately after seeding; in spring wheat apply after seeding but before wheat sprouts exceed 1/2 inch in length. Incorporate immediately after treatment 2 to 3 inches deep but above the wheat seed with 2 harrowings at right angles.

Precautions:

1	Seed wheat below incorporation depth (2 to 3 inches).
2	Do not disturb wheat seed with incorporation implement-usually a spike-tooth or Pne-tooth harrow followed by a second incorporation at right angles.
3	Do not graze treated areas.
4	Apply to a Prm seedbed that is not cloddy, trashy, or too wet for good incorporation.
5	Apply before weeds germinate.

Difenzoquat (Avenge)

Use at 0.625 to 1.0 pound of active ingredient per acre when the majority of wild oat plants are in the 3- to 5-leaf stage of growth. To control broadleaf weeds in addition to wild oat, difenzoquat may be tank mixed with 2,4-D, MCPA, bromoxynil, MCPA + bromoxynil, clopyralid + 2,4-D, and thifensulfuron + tribenuron.

For spray volumes of more than 10 gallons per acre, the addition of a surfactant is required. Consult label for surfactant to be used.

Precautions:

1	Use the lower rate for a wild oat population of 1 to 10 plants per square foot. Use a medium rate for 11 to 25 plants per square foot and the higher rate for more than 25 plants per square foot.
2	Do not apply when wheat bag leaf is exposed or crop injury may occur.
3	Rain within 6 hours of application will reduce effectiveness on wild oats.
4	Do not apply when freezing temperatures are forecast or when plants are wet with dew or rain.
5	Do not apply under severe conditions for plant growth such as drought, extreme temperature fluctuation, low soil fertility, and plant disease.

Diclofop (Hoelon)

Use 0.75 to 1.0 pound active ingredient per acre when the majority of annual grasses are in the 2- to 3-leaf stage but before the 1-node stage of wheat growth. Diclofop has soil activity and will control some grasses that emerge after application.

To save application costs, diclofop may be combined with broadleaf herbicides such as bromoxynil, MCPA, and thifensulfuron + tribenuron to control both grasses and broadleaf weeds. However, broadleaf and grassy weeds may not always reach the most sensitive growth stage simultaneously. Therefore, good judgment is necessary to evaluate which weed(s) may be the most serious competitor(s) with the crop in each situation where such combinations may be applied.

Precautions:

1	Do not apply phenoxy herbicides or dicamba within 5 days after diclofop treatment.
2	Do not allow livestock to graze treated field.

3	Do not harvest forage, hay, or straw from treated field prior to grain harvest.
4	Do not make more than 1 application per growing season.
5	Use the highest rate when wild oat is the principal problem.

GENERAL WEED CONTROL

Diuron and metribuzin are effective herbicides against both broadleaf and grass weeds. These herbicides are active through root uptake, as well as some foliar uptake, and often are strongly influenced by soil characteristics. However, these herbicides are more phytotoxic to both weeds and wheat on sandy soils with less than 1% organic matter.

Diuron (Karmex)

Apply 1.2 to 1.6 pounds active ingredient per acre immediately after planting winter wheat. Diuron may also be applied after wheat and weeds have emerged, but when weeds are less than 3 to 4 inches tall. Wheat is tolerant to diuron up to the jointing stage of growth.

Precautions:

1	Do not use on spring wheat.
2	Crop injury may result if severe winter stress, diseases, or insect damage follows herbicide application.
3	Do not use on coarse-textured soils (sands, sandy loams, gravelly soil), nor on soils containing less than 1% organic matter.
4	Do not treat wheat planted less than 1 inch deep.
5	Do not apply after wheat has reached boot stage.
6	Do not use with surfactant and nitrogen solution.
7	Do not replant treated areas to any other crop within 1 year after last treatment.

Metribuzin (Sencor/Lexone)

Apply 0.047 to 0.187 pound active ingredient per acre in the fall when winter wheat is in the 2-leaf stage, or 0.187 to 0.50 pound active ingredient per acre in the spring when wheat has more than 4 tillers and secondary roots have developed more than 1 inch in length.

Metribuzin is most effective when applied before grass weeds exceed the 2-leaf stage; therefore, lower rates in the fall are more effective than higher rates in the spring. When using sequential applications of metribuzin, allow at least 45 days between applications. Weed control with metribuzin is generally improved when a surfactant is used.

This herbicide may be tank mixed with bromoxynil, thifensulfuron + tribenuron, dicamba, 2,4-D, or MCPA. Tank mixes of metribuzin with thifensulfuron + tribenuron or bromoxynil have given good results in western Washington, especially on speedwell which is hard to control with other herbicides. Metribuzin may be applied in combination with triallate to control heavy grass infestation.

Precautions:

1	Use only on winter wheat.
2	Metribuzin may cause wheat injury, since some wheat cultivars are sensitive to this herbicide. Read the metribuzin label for sensitive cultivars and further precautions.
3	Follow label instructions regarding the use rate for different soils.
4	Do not use more than 0.5 pound active ingredient per year.
5	Wheat may be grazed 14 days following application, but do not harvest grain within 21 days after last application.
6	Do not use when wheat is under stress conditions such as winter kill, frost damage, disease, drought, or excessive moisture.

PERENNIAL WEEDS

Glyphosate (Roundup)

This herbicide is registered to control perennial weeds in wheat. It can be applied either before planting, as a spot treatment before the wheat heads, or after the soft dough stage. The target weed species should be in the optimum growth stage at the time of treatment. Use rates depend on the weed species to be controlled. For spot treatment, up to 10% of the total field area to be harvested may be treated. The wheat receiving spray in the treated area will be killed. Do not apply glyphosate if the weed is under stress as reduced weed control may result. Adding surfactant or ammonium sulfate will improve weed control. Do not apply if rain is expected within 6 hours after treatment.

PREHARVEST WEED CONTROL

Weeds which survive herbicide treatment or emerge late in the season may interfere with wheat harvest, deplete soil moisture, and produce large numbers of seeds that will cause problems in the subsequent crops. Glyphosate, dicamba, and 2,4-D are registered to control annual and perennial weeds prior to wheat harvest. Apply herbicides as broadcast or spot treatment. These herbicides may cause grain damage; do not use them when wheat is grown to produce seed for planting.

Glyphosate (Roundup).

Apply at 0.38 to 0.75 pound acid equivalent per acre when wheat is at hard dough stage (less than 30% moisture). Add 0.5 to 1% nonionic surfactant to improve weed control. Allow at least 7 days after application before harvesting wheat.

2,4-D

Apply at 0.5 to 0.95 pound active ingredient per acre when wheat is in hard dough stage and no green remains in stem node. Best results will be obtained when weeds are actively growing. Do not graze treated fields for two weeks after treatment.

Dicamba (Banvel)

For best results apply dicamba with 2,4-D. Use dicamba at 0.25 and 2,4-D at 0.5 pound active ingredient per acre. Apply when wheat is at hard dough stage and weeds are actively growing.

The herbicides listed below are currently registered for use in wheat; however, they

have been considered unsuitable in western Washington for one or more of the following reasons: (1) a high probability of wheat injury, (2) ineffectiveness on the weed species commonly infesting wheat, (3) inappropriate under the usual environmental conditions and/or managerial practices common to western Washington agriculture, (4) long soil carryover which may affect subsequent crops, and (5) availability of better and less costly alternative herbicides.

Imazamethabenz (Assert)

Fenoxaprop + 2,4-D + MCPA (Tiller)

Chlorsulfuron + metsulfuron (Finesse)

Chlorsulfuron (Glean)

Triphuralin (Trepan)

Linuron (Linex)

Tribenuron (Express)

Various combinations of 2,4-D, MCPA, dicamba, and bromoxynil, either as tank mixes or as formulated proprietary mixtures, can be used in wheat to improve broadleaf weed control. Consult the label for correct and registered procedures as to rates, timing and restrictions for each combination.

Table 1. Susceptibility of broadleaf weeds to herbicides.

Weed Species	Clopyralid	2,4-D	MCPA	Dicamba	Bromoxynil	Metribuzin	Diuron	Thifensulfuron+ tribenuron
Annual sowthistle	G	G	G	F	F	G	G	G
Birdseye speedwell		P	P	P	F	G	P	F
Black mustard	P	G	G	P	G	G	G	G
Bull thistle	G	G	G	F	P	P	F	F
Bur beakchervil		P	G	G	P	P	P	G
Canada thistle	G	F	F	F	P	P	P	F
Catchweed bedstraw		P	P	F	F	P	P	F
Chickweed	P	F	P	G	P	G	G	G
Coast Piddleneck		F	F	P	G	P	G	F
Common radish	P	G	G	P	F	G	G	G
Common lambsquarters	P	G	G	G	G	F	G	G
Common vetch	G	G	G	G	F	P	P	F
Common groundsel	G	P	P	G	G	F	F	G
Corn spurry		P	F	F	P	G	G	G
Field bindweed	P	F	F	F	P	P	P	P
Hairy vetch	G	G	G	G	F	P	P	P
Henbit	P	P	F	F	P	G	G	F
Indian mustard	P	G	G	P	F	P	G	G
Ivyleaf speedwell	P	P	P	P	F	G	P	F
Ladysthumb	F	G	F	G	G	P	F	G

Mayweed	P	F	P	G	G	F	G	G
Mouseear chickweed	P	F	P	F	P	G	G	G
Panicle willowweed		P	P			G	G	
Pineappleweed	P	F	P	G	G	P	F	G
Powell amaranth	P	G	G	G	F	F	G	G
Prostrate knotweed	P	F	P	G	F	F	F	G
Red deadnettle	P	P	F	F	P	G	G	
Redroot pigweed	P	G	G	G	F	F	G	G
Shepherds-purse	P	G	G	F	F	G	G	G
Spiny sowthistle	G	G	G	G	F	G	G	
Wild carrot		F	F	P	F	P	P	
Wild mustard	P	G	G	P	P	F	F	G
Wild buckwheat	G	F	F	G	G	F	F	F
Wild turnip		G	G	P	G	F	G	G
Wild radish		G	G	P	F	G	G	

G = good (85-100%) F = fair (70-84%) P = poor (0-69%) (-) = no information available

Table 2. Grass weeds' susceptibility to herbicide.

Weed species	Difenzoquat	Diclofop	Triallate	Diuron	Metribuzin
Annual bluegrass	P	P	P	G	F
Barnyardgrass	P	G	P	G	F
California brome	P	P*	P	P	P
Cheat	P	F	F	P	F
Green foxtail	P	G	P	G	P
Italian ryegrass	P	G	F	F	F
Quackgrass	P	P	P	P	P
Rattail fescue	P	P	P	G	G
Ripgut brome	P	G*	F	P	F
Soft chess	P	F*	F	P	F
Wild oat	G	G	F	P	P
Witchgrass	P	F	P	F	F

* Must be soil-incorporated
G = good (85-100%) F = fair (70-84%) P = poor (0-69%)

FIGURE 1. WHEAT GROWTH AND TIMING OF BROADLEAF HERBICIDE APPLICATIONS

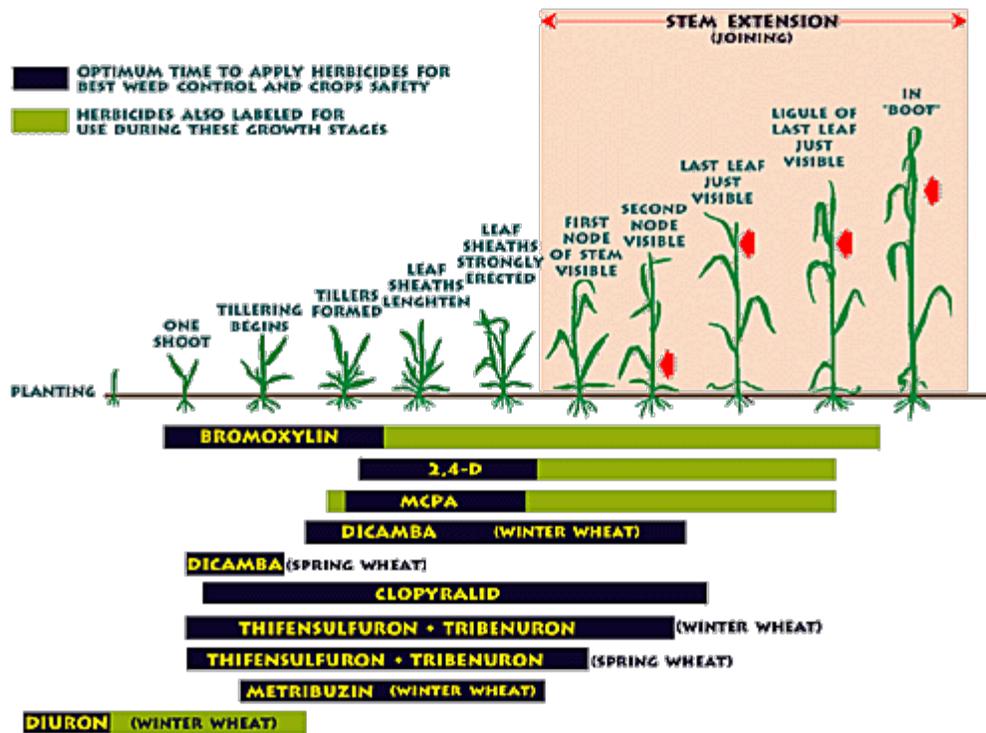
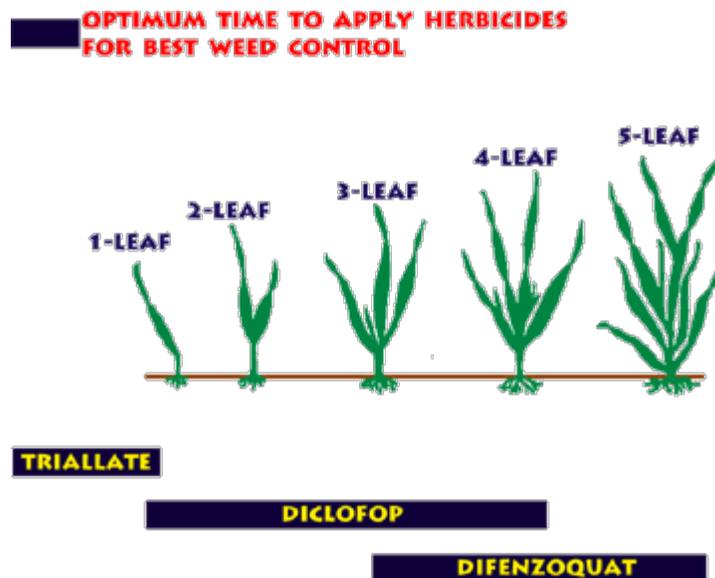


FIGURE 2. WILD OAT GROWTH STAGE AND TIMING OF APPLICATION FOR POSTEMERGENCE WILD OAT HERBICIDES



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▲Warning. Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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