Section 6

Weed Management

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The crop rotation system typically used in Kentucky can contribute to the control of certain weed species. Practices used in the establishment of no-till corn often break the life cycle of cool-season weeds such as common chickweed, purple deadnettle, or henbit before plants mature and produce seeds. A competitive wheat stand can help weed control in double-cropped soybeans by preventing or delaying emergence of warm-season weeds including crabgrass, cocklebur, and morninglories.

One drawback with this rotation system is that it may perpetuate certain problems. For example, Italian ryegrass often begins in wheat where its seed are easily spread during wheat harvest with combines. Ryegrass seedlings that develop from the scattered seeds during the fall after wheat harvest are able to overwinter and compete the following spring during the establishment of no-till corn. Heavy ryegrass infestations limit no-till corn stands by direct competition as well as harbor voles that feed on corn seed. Studies have shown that if ryegrass is not completely controlled in corn, escaped plants will produce seed and perpetuate the problem in wheat after corn harvest.

Another unique feature about growing wheat in a rotation with corn and double-crop soybeans is associated with the risk of crop injury caused by carryover of herbicide residues. Growers must use caution in selecting herbicides that do not persist in soil for long periods and cause injury to rotational crops.

The spectrum of weeds in conventional and no-tillage plantings of wheat is similar; however, there are some species that tend to be more troublesome where no-tillage practices are used. Wild garlic populations tend to be greater in no-tillage programs compared with programs that use plowing and disking for seedbed preparation. The infestation level of common chickweed, purple deadnettle, and henbit tend to be greater in no-till plantings than in conventional till plantings.

Photo 6-1. Italian or annual ryegrass *(Lolium rigidum)* is a problematic weed in wheat and must be aggressively managed.

Photo 6-2. Common Chickweed, *Stellaria media*

Common chickweed is a cool-season annual with white flowers that grows prostrate and is sparsely hairy. Mouseear chickweed (*Cerastium vulgatum*) is a similar species but has no leaf petiole, is very pubescent, and grows as a perennial.

Why Control Weeds in Small Grains?

The ability of weeds to compete and limit wheat yield will vary depending on the weed species. Italian ryegrass is the most competitive weed in wheat in Kentucky. One ryegrass plant per square foot can reduce wheat yield by approximately 4 percent. As much as 90 bu/A of yield loss of wheat has been measured in research trials on ryegrass. Common chickweed has a prostrate growth habit that forms dense mats and tends to be more competitive than purple deadnettle or henbit. In no-till plantings infestations of common chickweed can reduce potential wheat yield by 14 percent. However, the impact of these weeds is less where preplant tillage is used for preparing the seedbed.

Weeds can also affect the quality of harvested grain and harvesting efficiency. The aerial bulblets of wild garlic contaminate the grain during the harvesting process. Dockage due to bulblet contamination can vary due to a number of factors determined at the grain elevator. In some cases aerial bulblet contamination may be severe enough to render the grain unfit for sale at the elevator. Giant ragweed, common ragweed, johnsongrass, and marestail are examples of warm-season weeds that produce sufficient amounts of green vegetation in the spring that can reduce harvesting efficiency. The green vegetation may also lead to dockage due to increased moisture and foreign matter. Once wheat has been harvested, the clipped stubble of these weeds may survive and be difficult to control with burndown applications in double-cropped soybeans.

Weed Scouting

Periodically monitoring fields helps detect problems before weedy plants become too large to control effectively. Critical periods for monitoring weeds are:

- **Early October.** Near the time of planting, especially in no-tillage plantings, watch for cool-season weed species that cause problems in wheat.
- **Mid- to late November** (about one month after planting). Once wheat has emerged, watch for cool-season annuals, such as common chickweed, henbit, purple deadnettle, or Italian ryegrass. These weeds initiate growth during early fall and sometimes grow too large to control effectively with spring applications of herbicides.
- **Early March to early April.** Begin monitoring soon after wheat recovers from winter dormancy, but before plants are jointing, because some herbicides need to be applied after tillering but before the jointing stage.

Photo 6-3. Shepherd's-purse, *Capsella bursa-pastoris*

Shepard's purse is a cool-season annual that grows 12 to 18 inches tall when mature. Rosette leaves are deeply lobed, and stem leaves are arrow-shaped with clasping leaf bases. Its flowers are white with four petals, and its triangular- or heart-shaped fruit is about ¼ inch long.

Photo 6-4. Field Pennycress, *Thlaspi arvense*

Field pennycress is a cool-season annual with four-petal white flowers. Its basal leaves are egg-shaped and have petioles, while middle and upper leaves are without petioles and have clasping leaf bases. Seed capsules are oval and notched at the tip. Mature plant grows 4 to 20 inches tall.

Photo 6-5. Marestail—also referred to as horseweed, *Conyza canadensis*

Marestail is an annual that grows 1 to 6 feet tall when mature. Seedlings normally grow as rosettes in fall or late winter and bolt (develop elongated stems) in early to late spring. Stems are hairy and are erect unless damaged from herbicides or mowing. Leaves are hairy with entire or slightly toothed margins. Seed are small achenes that are attached to a pappus or group of hairs.

Photo 6-6. Purple Deadnettle *(Lamium purpureum)*, left, and Henbit *(Lamium amplexicaule)*, right.

Both are cool-season annuals with square stems and reddish to purple flowers. Mature plants grow about 4 to 16 inches tall. Purple deadnettle has uppermost leaves that tend to be reflexed (turned downward) and all leaves occur on petioles. Henbit leaves are not reflexed and its lower leaves have petioles while mid- to upper leaves have no petioles.

- **Late May to early June.** After wheat has headed, watch for emerging warm-season weeds. A preharvest treatment after the hard-dough stage may be needed to control weeds and improve harvesting efficiency of wheat, especially where wheat stands are poor and weed infestations are heavy.

Scouting Procedures for Weeds in Wheat

Pertinent weed information can be recorded on paper or digitally on hand-held recording devices such as a PDA (Personal Data Accessory) or a PC tablet. An advantage for using the computer devices is that they can be equipped with GPS technology or connected to a separate GPS unit to help develop field maps and facilitate keeping permanent records of problem weeds for each field.

Step 1. Randomly select survey sites so they are representative of the entire field. Do not survey within 100 feet of a fence or roadway. As Table 6-1 indicates, the minimum number of sites varies according to field size. At each survey site, walk forward 60 feet (approximately 20 steps) and observe for weeds occurring within 5 feet on either side (see Figure 6-1). Each site should be approximately 600 square feet.

Step 2. Infestation levels of weeds can be recorded as estimates of the percentage of ground cover occupied by each species or plant counts within a given area.

For broadleaf weeds and weedy grasses, estimate the percent ground cover at each survey site. A general guideline for categorizing ground cover is: light (<5%), moderate (5% to 30%), and severe (>30%). It might help to visualize the total percentage occupied by all weeds, then estimate the percentage occupied by each weed species so that the sum of all species equals the total. For example, at the first site you visit, you estimate that the total ground cover occupied by all

Table 6-1. Minimum number of survey sites based on field size.

Field Size (ac)	Number of Survey Sites
1-20	3
20-30	4
30-40	5
40-50[a]	6

a For fields larger than 50 acres, increase number of sites by 1 for each additional 10 acres.

Figure 6-1. Survey diagram.

weeds is approximately 20 percent. You then determine that common chickweed occupies about half of the weed cover, with henbit and Italian ryegrass accounting for the remaining space in equal proportions. Based on these observations, common chickweed accounts for 10 percent of the ground cover (i.e., moderate infestation) and henbit and ryegrass each account for 5 percent of the ground cover (i.e., light infestation).

Use plant counts for describing infestation levels for wild garlic. Estimate the infestation of wild garlic at each site as light (one plant per 600 square feet), moderate (two to five plants per 600 square feet), or severe (more than five plants per 600 square feet). It is not necessary to count all wild garlic that occurs in clusters of small plants because only a few, if any, of the small plants occurring in groups develop aerial bulblets. Focus primarily on single plants, and count each cluster of small plants as a single plant.

Step 3. Record the average size or growth stage of each weed species present in the field. The size of cool-season broadleaf weeds that have a low or spreading growth habit is often based on diameter instead of height of plant. Cool-season grasses are defined by growth stage (number of leaves on main stem of seedlings or number of tillers on established plants). This information can help you select herbicide options and determine when to treat.

Step 4. A field map can be used to show general locations of survey sites and problem areas not included in the survey sites. A weed map helps chart special weed problems and may isolate areas of the field that need treatments. The map can also be a useful reference for planning future weed control programs. Figure 6-2 is a sample weed map of a wheat field.

Photo 6-7. Yellow Rocket, *Barbarea vulgaris*

Yellow rocket is a cool-season annual or biennial that grows 1 to 2 feet tall when mature. Rosette leaves have large terminal lobes and one to four lateral lobes. Upper leaves become progressively smaller and are less deeply lobed. Flowers are yellow with four petals. Seed pods are cylindrical, about 1 inch long and nearly square in cross section.

Figure 6-2. Sample weed map.

Economic Thresholds

Economic thresholds for weeds in wheat are not well defined; consequently, growers need to rely on their personal experience to determine if a herbicide treatment is warranted. General treatment guidelines are in Table 6-2 and vary depending on several factors including weed species, cost of treatment, and price of wheat.

Table 6-2. Treatment guidelines for wheat.

	Infestation level[a]		
	Weed Cover	Wild garlic counts/600 sq ft	Treatment Guideline[b]
Light	<5%	1	Probably no economic benefit to treat
Moderate	5 to 30%	2 to 5 plants	Treatment may or may not be justified
Severe	>30%	>5 plants	Treatment may be justified if implemented in a timely manner.

a The infestation level is the total weed cover (in the fall) or wild garlic counts (in the spring) averaged across survey sites. In some instances the average infestation level may suggest no need for treating, yet a few sites may be heavily infested and warrant control. It may be feasible to spot-treat portions of a field where severe infestations occur based on a weed map.

b Light infestations of problem weeds such as Italian ryegrass may still warrant treatment in order to limit spread of weed seed.

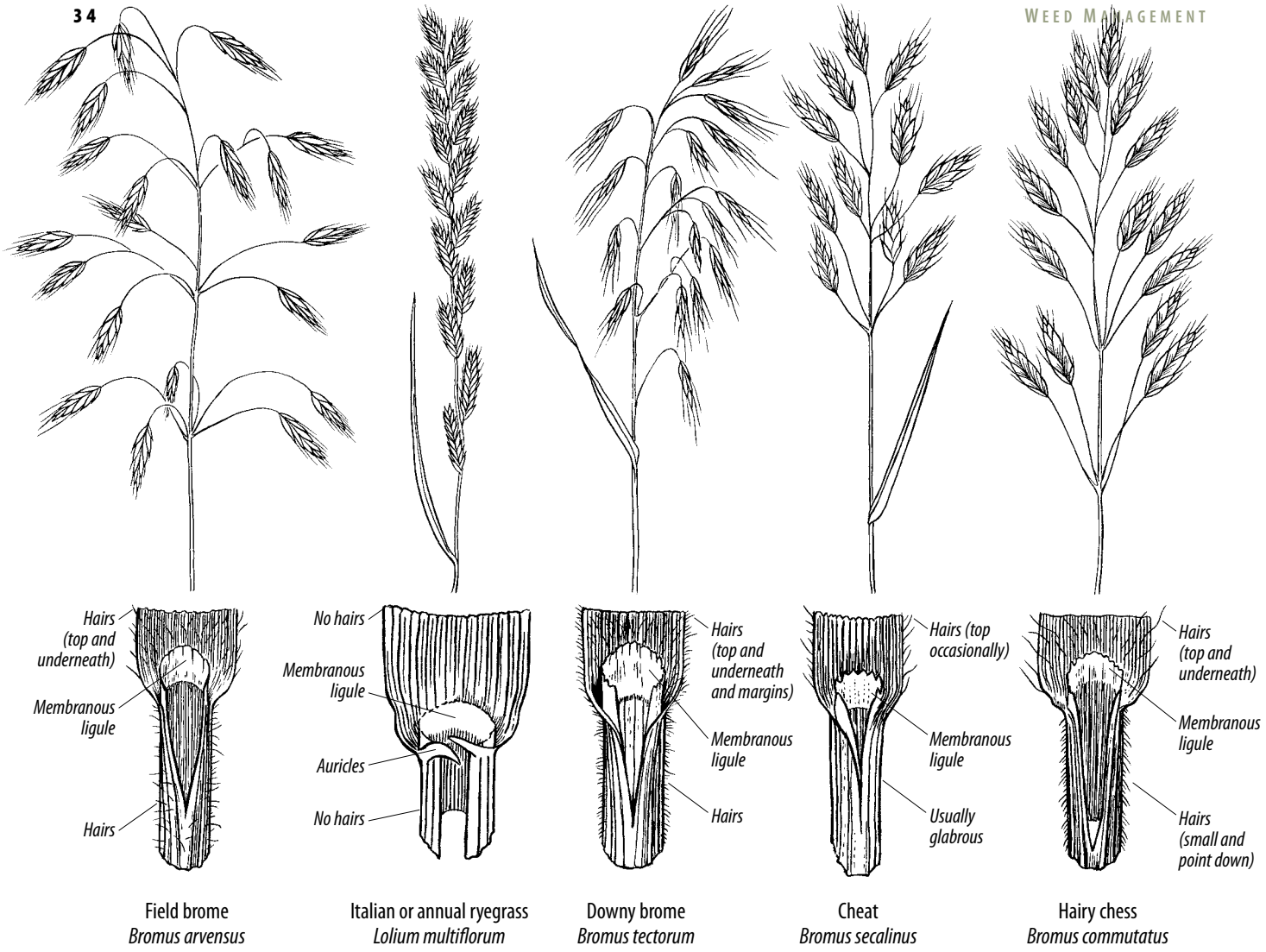
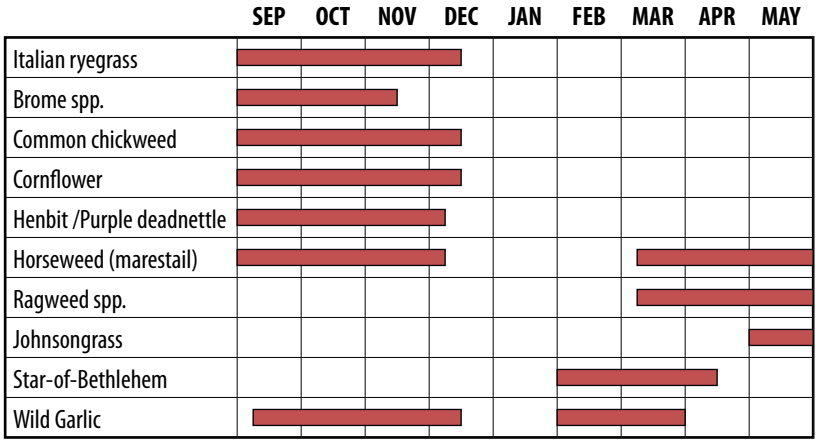


Figure 6-3. Drawings of grass species that occur as weeds in wheat in Kentucky.

Weed Identification

Correctly identifying weeds during their early stages of development is important to help select and initiate successful control strategies. Many weed species look similar during early stages of development. Vegetative characteristics such as shape, color, arrangement of leaves, and location of pubescence (hairs) can aid in identification; providing these characteristics remain consistent under a wide variety of conditions. However, it is not unusual for these vegetative characteristics to vary for some weed species, so they are not always reliable for identification. See the illustrations in this section for descriptions and visual aids to be used in identifying weed species.

Figure 6-4. Approximate Time of Significant Emergence of Weeds in Wheat in Kentucky.*



*Some cool-season species, particularly ryegrass, may continue to emerge sporadically throughout winter and early spring when conditions are favorable for emergence.

Photo 6-8. Corn Speedwell, *Veronica arvensis*

Corn speedwell is a cool-season annual that grows prostrate. Its lower leaves are opposite, have petioles and are rounded at the base. Upper leaves may be alternate and do not have petioles. Leaves and stems have fine hairs. Ivyleaf speedwell (Veronica hederifolia) looks similar, but its leaves have larger toothed margins and more flat or truncated leaf bases.

Photo 6-9. Wild Garlic, *Allium vineale*

Wild garlic is a perennial that grows 1 to 3 feet tall when mature. It has hollow round stem-like leaves and underground bulbs. Aerial bulblets occur in cluster(s) at the top of the plant. Wild onion (Allium canadense) looks similar, but its stem-like leaves are flat and are not hollow. Star-of-Bethlehem (Ornithogalum umbellatum) also looks similar, but it does not have the garlic odor and its leaves are somewhat flat with a pale midrib.

Weed Control—An Ongoing Process

The timeline for emergence of various weed species in wheat (Figure 6-4) illustrates why weed management can be an ongoing process beginning prior to planting up through wheat maturity.

An effective overall weed management program for Kentucky wheat involves a combination of cultural and chemical practices.

Cultural Practices

Establishing and maintaining a competitive wheat stand contributes to weed control. A seeding rate that results in a minimum of 25 wheat seedlings per square foot is ideal for achieving optimum wheat yields and often limits the amount of weedy vegetation. Planting wheat in narrow rows increases the likelihood for achieving early-season shading and competition to weeds compared with wheat planted in wide rows. Applying nitrogen at recommended rates and times can promote tillering of wheat and limit the presence of warm-season weeds that affect harvest.

Crop rotation often reduces weed populations. For example, infestation levels of wild garlic, common chickweed, and henbit tend to be lower following corn than soybeans. A rotation of corn/wheat/double-crop soybeans is common in Kentucky and is often more favorable for managing weeds in wheat than a soybean/wheat/soybean rotation.

Preplant tillage was once the only option for managing such weeds as wild garlic and certain cool-season weedy grasses in wheat. There are a number of drawbacks with tillage including added fuel, time, and erosion. Unless wheat is organically grown, herbicides have often replaced the need for using tillage for weed control.

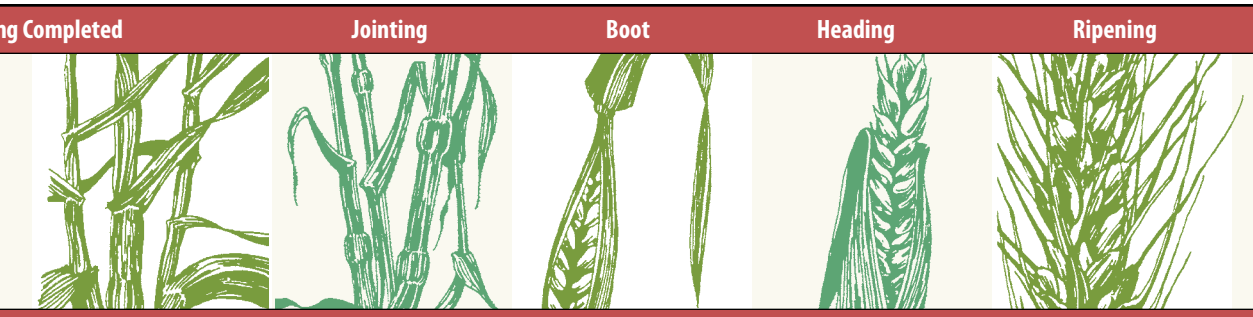
Growing wheat in rotation with corn and soybeans can be beneficial in controlling broadleaf weeds, such as common chickweed or henbit. The timely use of burndown herbicides or preplant tillage in corn or soybeans limits production of weed seed by destroying cool-season weeds before they mature.

Sanitation is an effective preventative option for limiting the spread of Italian ryegrass. Clipping infested field borders and waterways ahead of wheat harvest can limit the spread of ryegrass seed; however, it is critical to clean equipment after mowing infested areas. Harvest infested fields last. Cleaning combines after harvesting infested areas is especially important. In instances where a portion of wheat seed is being saved for next season's crop, care should be taken to avoid using crop seed harvested from ryegrass infested areas. Also, cleaning the harvested wheat seed is important in limiting the spread of seed in future crops.

Chemical Control

Herbicides play a major role in managing weeds in wheat. Herbicide recommendations for wheat production are discussed in the Cooperative Extension bulletin *Chemical Control of Weeds in Kentucky Farm Crops* (AGR-6). Always read and follow the restrictions and precautions stated on the label of herbicide products.

Winter Wheat Calendar



March | April | May | June | July

Apply PGR

Prepare combine for harvest

lication

Start harvest

gle nitrogen application

Start variety selection

e stand counts

Plant double-crop soybeans

Assess winter injury

Plan for next crop

Finish harvest

s and armyworms

Scout for aphids, armyworms, cereal leaf beetle

Scout for diseases: spray if needed

garlic, henbit,
d other weeds

Clean and spray storage bins, prepare dryer

re

Aerate to warm grain

Prepare a marketing plan

Treat grain for long-term storage

Summarize and analyze
Enterprise Costs and Returns (past and present)

Photo 6-10. Hairy Chess *(Bromus commutatus)*, left, and Italian Ryegrass/Annual Ryegrass *(Lolium multiflorum)*

Hairy chess is a cool-season annual that grows 1 to 3 feet tall. The leaf blade has hairs, and the leaf sheath has hairs pointed downward. There are no auricles. Cheat, downy brome, and field brome are similar in appearance to hairy chess.

Ryegrass is a cool-season annual that grows 1 to 3 feet tall. The leaf blade is glabrous (no hairs), and the leaf sheath is glabrous and shiny. Clasping auricles are present at the leaf collar.

Examples of issues that need to be considered when using herbicides for weed control in wheat are: 1) application timing, 2) compatibility with other chemicals, 3) varietal sensitivity, 4) herbicide-resistant weeds, 5) herbicide carryover, 6) harvesting restrictions for grain or forage, and 7) cleaning spray equipment.

Application timing. The four periods of time when wheat herbicides are applied are: 1) before wheat emergence, 2) postemergence in the fall, 3) postemergence in late winter or early spring, and 4) preharvest. Important issues associated with each timing and some of the factors that determine when treatments should be applied are discussed below.

Before wheat emergence. Fields planted to no-till wheat often require a foliar-applied burndown herbicide such as glyphosate or paraquat. These herbicides will control grasses and broadleaf weeds and can be applied before or after wheat planting but before wheat emerges. Paraquat is a contact herbicide that is labeled to control annual weeds up to six inches in height. It is usually applied in 20 to 40 gallons of clean water or clear liquid fertilizers per acre. Glyphosate is a translocated herbicide used to control annual and perennial weeds. It is often applied in 10 to 20 gallons of water per acre

The use of soil-residual herbicides ahead of wheat emergence is not widely adopted in Kentucky, yet there are occasions where they can help prolong early-season control of some weeds. For example the premix of chlorsulfuron plus metsulfuron (Finesse) can be applied prior to wheat to help suppress emergence of Italian ryegrass. When applied at the high labeled rate, diclofop (Hoelon) offers both premergence and postemergence ryegrass control prior to wheat emergence. Diclofop can also be applied after wheat emergence because of its foliar activity to grassy weeds and safety to wheat. A strategy that growers use to limit expenses with diclofop is to apply preemergence treatments around field borders or areas of heavy infestations where Italian ryegrass problems often begin.

Fall postemergence applications. The likelihood of achieving optimum wheat yield tends to be greater when cool-season broadleaf weeds such as common chickweed, henbit, or purple deadnettle are controlled in the fall rather than in the spring. This is particularly true for no-till plantings. The level of control of these broadleaf weeds is essentially the same regardless of whether treatments are applied in the fall or spring; however, fall tends to be a more favorable timing for optimum control of such weeds as cornflower, annual bluegrass, Italian ryegrass, and certain Brome species.

Fall postemergence sprays can be made soon after wheat emergence and continue though late fall, providing weather conditions are favorable for plant growth. Most postemergence herbicides used in wheat rely on foliar absorption to control weeds; consequently, plants should be actively growing in order to achieve optimum weed control and crop safety. Dry conditions can delay weed emergence, particularly Italian ryegrass. Cold and dry conditions may also delay herbicide activity and in some cases limit weed control. Heavy rainfall, prolonged cold temperatures, or widely fluctuating day/night temperatures before, during, and shortly after application may lead to crop injury, particularly with Acetolactate Synthase (ALS) inhibitor herbicides such as thifensulfuron (Harmony) and mesosulfuron (Osprey).

There are a few soil-residual herbicides that can be applied after wheat emergence. It is unlikely these will provide season-long weed control, yet they can be helpful if conditions are conducive for activity. Extremely dry conditions,

Photo 6-11. 2,4-D or Banvel (dicamba) injury. Wheat treatment during boot stage of growth with auxin-type herbicides result in trapped heads, missing florets, or twisted awns.

Photo 6-12. Atrazine or Princep (simazine) carryover. Wheat plants emerge, then dieback from leaf tips of oldest leaves.

Photo 6-13. Command (clomazone) carryover. Wheat plants emerge and often have chlorotic or bleached appearance. Plants may recover from early-season injury.

or a seedbed that is cloddy or has a lot of surface residue from the previous crop, may limit control from certain soil-residual herbicides. The premix of flufenacet + metribuzin (Axiom) is an example of a soil-residual herbicide that also offers limited foliar activity for seedling weeds present at the time of application. However, pendimethalin (Prowl H_2O) is an example of a soil-residual herbicide that has no foliar activity and may need a foliar-applied herbicide as a tank-mix partner for managing weeds that are emerged at the time of application.

Late winter—early spring postemergence applications. Wild garlic emerges during the fall and early spring months. Achieving optimum control of this weed is important; therefore, growers tend to delay herbicide applications until late winter or early spring to ensure that most of the population of wild garlic plants has emerged. It is not unusual for growers to apply postemergence herbicides during this time for managing cool-season broadleaf weeds and grasses, especially if conditions in the fall were not favorable for weed emergence and growth.

Several postemergence herbicides can be applied when wheat is coming out of dormancy and in Feekes growth stage 5 (Zadoks 30). This timing usually occurs in March and will vary depending on environmental conditions. Some postemergence herbicides may also be applied up to boot stage, yet growers seldom wait this late to make applications.

Crop injury from 2,4-D is associated with such factors as rate, formulation, and wheat growth stage. Injury may be a risk with the high labeled rate, particularly with ester formulations. The risk of injury from 2,4-D is least when crop plants are fully tillered (Feekes 5, Zadoks 30) but before jointing (Feekes 6, Zadoks 31). Although some 2,4-D labels do not prohibit applications after initiation of the first joint, they do prohibit applying to plants that are in the boot (Feekes 8, Zadoks 37) to dough stage (Feekes 11.2, Zadoks 85). Research has shown that applications of 2,4-D in the fall before wheat is fully tillered can injure wheat and reduce yield by as much as one-third.

Dicamba (Banvel or Clarity) is a growth regulator herbicide that is similar to 2,4-D. While dicamba may be applied in the fall or early spring; it is important that treatments be made prior to jointing (i.e. Feekes 6, Zadoks 31) in order to avoid crop injury. See Photo 6-11 for injury symptoms when 2,4-D or dicamba is applied during the boot stage.

Preharvest treatments. Preharvest treatments are not a part of a planned weed control program but are often used as salvage treatments to help prevent such weeds as Pennsylvania smartweed, ragweeds (common and giant), and johnsongrass from impeding wheat harvest and competing for soil moisture in double-crop soybeans. However, research has shown preharvest treatments are not effective in preventing production of viable seed of such weeds as Italian ryegrass.

Glyphosate and certain formulations of 2,4-D are examples of herbicides registered for preharvest weed control in wheat. The response of weeds to these herbicides is slow and does not occur as rapidly as with certain harvest-aid applications used in other crops. Drift to nearby sensitive crops is a concern when using these treatments. Preharvest treatments can injure wheat or reduce seed germination or seedling vigor and are not recommended for wheat grown for seed production.

Herbicide compatibility with other chemicals. Herbicides can interact with other chemicals when tank mixed with one another or applied near the same time. These interactions can occur between herbicides or other pesticides (especially organophosphate insecticides) as well as fertilizers or additives. Consult the label(s) for potential problems

Photo 6-14. Wheat with no injury symptoms (left). Wheat injured by Opsrey herbicide (mesosulfuron-methyl) (right). Leaf burn is more likely to occur when fertilzer N is applied within 14 days of the Opsrey application.

with physical compatibility of the mixtures as well as the potential for crop injury or poor weed control. Also, be certain the application timing is within the recommended period for all chemicals involved.

The following are examples of problems associated with compatibility issues:

Osprey and nitrogen fertilizer. Liquid nitrogen fertilizer is often used at low rates as a spray adjuvant with foliar-applied herbicides. However, applying herbicides near the time of topdressing nitrogen fertilizer can lead to crop injury from certain ALS inhibitor herbicides. For example the label for Osprey indicates topdress applications of liquid nitrogen fertilizer may occasionally cause transient leaf burn and stunting when applied within 14 days of an Osprey application (see Photo 6-14). Research has shown that applying Osprey and topdressing nitrogen fertilizer within a few hours of one another on the same day can limit wheat grain yield by 12.6 bu/A. It is important to consult the herbicide label for any precautions regarding timing for topdressing nitrogen fertilizer.

Harmony Extra + liquid fertilizer + nonionic surfactant. Stunting and yellowing of wheat can occur when liquid nitrogen fertilizer is used as the carrier in place of water. Injury associated with this mixture sometimes can be reduced by using the lowest recommended rate of nonionic surfactant and applying the mixture during favorable weather conditions.

Harmony Extra + diclofop (Hoelon). This mixture can reduce ryegrass control with Hoelon. Applying these products separately, approximately seven days apart helps prevent antagonism associated with this mixture.

Harmony Extra + 2,4-D. Theses two herbicides are frequently applied together as a tank mix combination, yet the application timing of 2,4-D is not always compatible with Harmony Extra. This mixture should be applied in the spring after wheat has fully tillered and before jointing. Fall sprays of this mixture can limit tillering and cause other growth regulator symptoms to appear during later stages of wheat development.

Varietal Sensitivity. Wheat varieties may vary in their susceptibility to certain herbicides. Metribuzin is an example of a wheat herbicide that can vary in its ability to cause crop injury based on variety. The labels of products containing metribuzin list wheat varieties sensitive to metribuzin. Testing of varietal response to herbicides is not an ongoing process, which limits the ability to know sensitivity of newly released varieties. When information on varietal sensitivity is not known, treat only a small area until sensitivity is established before treating large acreages.

Herbicide-resistant weeds. Herbicide resistance is the ability of certain biotypes within a weed species to survive a herbicide that would normally control it. A biotype is a naturally occurring individual of a species that often looks the same but has a different genetic makeup than other individuals of the species. The difference in genetics among biotypes within a species accounts for the presence of herbicide-resistant weeds.

There are isolated populations of Italian ryegrass in Kentucky that are resistant to the ACCase inhibitor herbicide diclofop (Hoelon). Scientists have shown that the resistance of Italian ryegrass to ACCase inhibitor herbicides is not well defined. For example, pinoxaden (Axial XL), another ACCase inhibitor, may control certain biotypes resistant to Hoelon, yet not other Hoelon-resistant biotypes. This inconsistent response to Axial XL makes it difficult in identifying resistant problems for this species.

Resistance to ALS inhibitor herbicides has been reported as a major problem in other wheat production regions of the United States, but not in Kentucky or neighboring states. The fact that sulfonylurea herbicides, which are ALS inhibitors, are widely used in Kentucky makes it important that growers be on the lookout for problems with ALS resistance.

The potential for weed resistance to develop increases with repeated use of herbicides that have the same site or mode of action. Therefore, monitor herbicides used in all rotational crops and use production practices that prevent or reduce the potential for the development of herbicide-resistant weedy biotypes.

Herbicide carryover. Injury due to carryover of herbicide residues is a concern when growing wheat in rotation with corn and double-crop soybeans. Growers must use caution in selecting herbicides that do not persist in soil for long periods and cause injury to rotational crops. While wheat injury due to carryover of atrazine residues has not been a widespread problem in Kentucky, the atrazine label warns that the risk of injury may occur. Simazine is chemically similar to atrazine, but may pose a greater threat to carryover injury to wheat than atrazine. There is a significant risk of injuring wheat where clomazone (Command) was used the previous spring in other crops. See Photos 6-11, 6-12, and 6-13 for injury symptoms due to herbicide carryover.

Certain ALS inhibitor wheat herbicides persist in soil and injure double-cropped soybeans. Dry weather and high soil pH are conditions that prolong the persistence of many ALS inhibitor herbicides. Products that contain such active ingredients as chlorsulfuron (Finesse or Finesse Grass & Broadleaf), metsulfuron (Finesse), propoxycarbazone (Olympus Flex), or sulfosulfuron (Maverick) have potential to injure double-cropped soybean. It is important that growers consult labels for the required rotational interval and any recommendation on planting a Sylfonylurea Tolerant Soybean (STS) variety.

Harvesting restrictions. Most herbicides used in wheat have label restrictions regarding use of the crop as grain or for forage purposes. The EPA has established these restrictions to prevent illegal residues in the harvested grain or forage for livestock feed. When more than one product is included in the spray tank mixture, follow the label that is most restrictive.

Cleaning spray equipment. If spray equipment is not rinsed properly, herbicide residues can accumulate in the spraying system and dislodge in subsequent applications, causing injury to susceptible crops. Check the herbicide label for recommended procedures for cleaning equipment. The procedures may appear cumbersome but are often necessary to remove small amounts of herbicide that could injure other crops.