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Cultural Practices to Improve Weed Control in Winter Wheat

Drew J. Lyon, Extension Dryland Cropping Systems Specialist; Alex R. Martin, Extension Weed Specialist; and Robert N. Klein, Extension Cropping Systems Specialist

This NebGuide explains the influence of cultural practices on weeds in winter wheat.

A good stand of vigorously growing winter wheat will have fewer weeds than a thin stand. Poor wheat stands and lack of plant vigor often result from poor soil moisture management during the fallow period before winter wheat seeding.

Precipitation and temperature greatly influence crop and weed growth in the semiarid areas of the central Great Plains. Annual average precipitation in Nebraska varies from 14 to 24 inches where fallow is practiced. The purpose of fallow is to store water in the soil to stabilize winter wheat yields and to manage weeds. With good fallow practices, sufficient soil water is usually available to establish winter wheat.

Several methods of weed management are available in winter wheat production. Cultural practices that improve weed control include crop rotation, timely weed control during summer fallow and crop growth, a firm seedbed at wheat seeding, proper variety selection, use of quality seed, optimal seeding dates, seeding rates, row spacings, row direction, seeding techniques and soil fertility.

Crop Rotation

Crop rotation is an important component of integrated weed management. Several crop rotation sequences are used when growing winter wheat in Nebraska. Winter wheat-fallow, winter wheat-corn or grain sorghum-fallow, winter wheat-corn-soybean, and continuous winter wheat are the most common rotations. Proso millet and sunflower are also commonly used in rotations with winter wheat.

Weeds with the same life cycle as the crop tend to increase under monoculture. Winter annual weeds, particularly the grasses, tend to be the most common weeds in winter wheat. Downy brome, hairy chess, jointed goatgrass, feral rye, and volunteer wheat are most troublesome when winter wheat is grown continuously or every other year on the same land. Winter annual broadleaf weeds also increase but can be readily controlled in the growing winter wheat with herbicides.

Inserting a warm-season crop such as corn, grain sorghum, proso millet, soybean, or sunflower into a winter wheat-fallow rotation can break the life cycle of these economically important winter annual weeds. Any regionally adapted warm-season crop will suffice and serve as an important weed management tactic. A cool-season spring crop such as spring wheat or oat is not as effective as a warm-season crop at disrupting the life cycle of winter annual weeds. These weeds can emerge as late as mid-April, after the cool-season crops are planted and established and may still produce seed.

A rotation of winter wheat-corn-fallow is an excellent choice for managing winter annual weeds in winter wheat and for providing good yields. However, reducing the duration of the pre-wheat fallow period, for example, by planting winter wheat immediately after a summer annual crop like corn for silage or soybean, often results in wheat stands of reduced vigor due to limited soil water or planting beyond the optimum planting date. The winter wheat is less competitive, resulting in increased weed growth in the wheat and following harvest *(Table I)*. This is less of a problem in eastern Nebraska where greater fall precipitation occurs and wheat can be planted later.

An important reason for rotating winter annual and summer annual crops is to deplete the soil weed seed bank. With two or more years between winter wheat crops, soil weed seed banks decline to levels where the weeds that do grow may be more easily managed. Due to the increased longevity of jointed goatgrass seed, a four-year rotation is encouraged if jointed goatgrass is a problem.

Table I. Effect of crop rotations in 174 Nebraska fields on winter wheat yield and weed density following winter wheat harvest.[1]

			Weed density		
Rotation	*Fallow duration*	*Wheat yield*	*Green foxtail*	*Longspine sandbur*	*Kochia*
	(months)	(bu/acre)	(no./yard^2)		
Wheat-fallow	14	62	0.2	1.7	<0.1
Wheat-corn-fallow	11	63	1.1	0.8	<0.1
Continuous wheat	2	48	2.3	<0.1	<0.1
Wheat-corn-spring small grain	1	40	6.7*	1.7	0.3
Wheat-corn-soybean	0	47	1.5	<0.1	0.4
Wheat-corn or sorghum	0	39	0.9	3.8	2.4*

[1]Adapted from Wicks et al., Weed Technology 17:467-474.
*Indicates value is significantly different from the value for wheat-fallow at the 5 percent level.

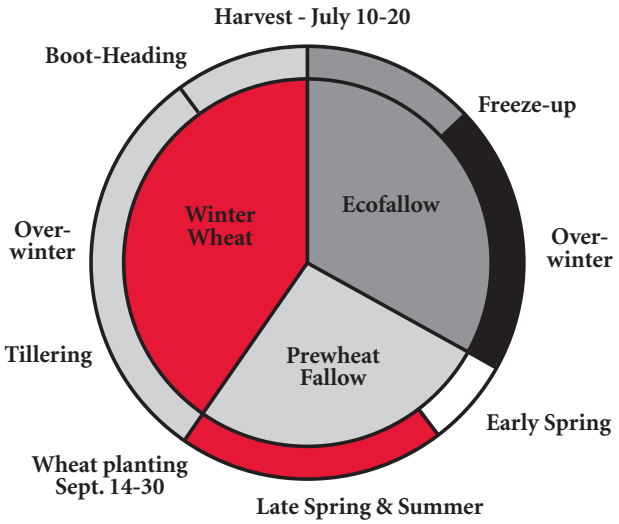

Figure 1. Winter wheat-fallow rotation.

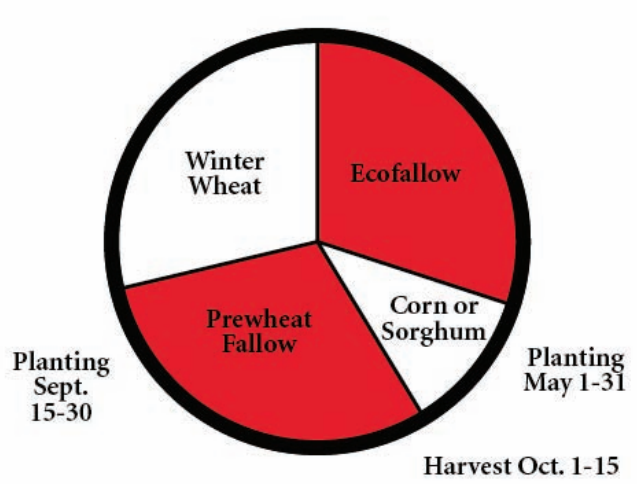

Figure 2. Winter wheat-corn or sorghum-fallow rotation.

Fallow Weed Control

Effective weed management during the ecofallow and pre-wheat fallow periods (*Figures 1* and *2*) is critical to preserve soil water, eliminate weed seed production and disrupt insect and disease pests. Ecofallow is the period from winter wheat harvest until early spring or planting of a warm-season crop. Pre-wheat fallow is the period from early spring or the harvest of a summer annual crop until winter wheat is seeded. Herbicides, tillage, or both may be used to achieve weed control during these fallow periods. Herbicides maintain greater residue cover than tillage, which helps to reduce soil erosion and increase soil water storage. If tillage is used, it should preserve as much residue on the soil surface as possible. See University of Nebraska–Lincoln Extension publication, EC130, *Nebraska Guide for Weed Management*, for details on herbicide use in fallow periods.

Volunteer wheat is a host for the Russian wheat aphid and the wheat curl mite, which is the vector of wheat streak mosaic virus and High Plains disease. Volunteer wheat should be controlled throughout the fallow periods, but it is critical that it be completely eliminated for at least a week between wheat harvest and wheat seeding. This is known as "breaking the green bridge" and it prevents the carryover of these insects from one wheat crop to the next by depriving the insects of a food source and a means to survival.

High temperatures during July and August often stress volunteer wheat and weeds and reduce the efficacy of herbicides applied shortly after wheat harvest. Additionally, broadleaf weeds that have had their tops cut off by the combine are difficult to control with herbicides. Although tillage can work well at this time of year, it must commence shortly after harvest or soils may become too hard for tillage equipment to penetrate.

If herbicides are not used to control weeds during fallow, begin tillage before soils are too dry and hard for implements to function properly. If tillage is going to be used, the first tillage operation should usually occur before July 1 in the pre-wheat fallow period. During this period, a sweep plow, tandem-disk harrow, offset disk, chisel plow, and/or herbicides may be used to kill weeds before they remove appreciable soil water. The number of tillage operations needed depends on precipitation, the weed species present, slope, susceptibility to erosion, and how much crop residue the drill can handle. Sweep tillage does not control weeds when soil is moist; therefore, disks are often used although they destroy more crop residue. Herbicides are typically a better option for weed control than tillage when soils are moist. Common purslane is especially hard to control with tillage. See *Nebraska Guide for Weed Management* (EC130), for details on using herbicides to control common purslane during fallow periods.

Seedbed Preparation

A firm seedbed enhances wheat seed germination and seedling growth. Residues should be maintained on the soil at seeding to help prevent wind and water from silting under the winter wheat seedlings or burying the seeds too deep. If tillage was used during the previous fallow periods, the rodweeder should be used to control weeds during the final two to four weeks before seeding wheat and to create a firm seedbed. In areas where winter annual weeds are a problem, rainfall prior to wheat seeding can cause weed seeds to germinate and set the stage for control. Following rain, rodweeding and wheat seeding should be delayed at least one week to aid in controlling winter annual weeds. This delay has effectively controlled downy brome and prevented grain yield losses up to 69 percent. Downy brome is more of a problem in early planted fields than in later planted fields; however, it is important not to delay wheat seeding much beyond the optimum planting date or yields will be reduced.

Variety Selection

Selecting adapted competitive winter wheat varieties is important. Research and field surveys have shown a large difference in weed suppression characteristics of winter wheat varieties *(Table II)*. Tall wheats competed better with weeds than short varieties in two out of three years. Other factors that may improve wheat's competitiveness with weeds include rapid early fall growth, good tillering, winter hardiness and extensive leaf display.

Table II. Effect of winter wheat varieties on summer annual weed density at North Platte.[1]

Variety stature	*1983*	*1984*	*1985*
	number/meter^2		
Medium tall	40	58	10
Medium	44	55	12
Medium short	438	111	14
Short	483	122	5
LSD (5%)	160	45	NS

[1]Adapted from Wicks et al., Weed Science 42:27-34.

Seed Quality

Planting crop seeds containing weed seeds has been the most common method of spreading weeds for centuries. Drill box surveys in Kansas and Nebraska have shown that many wheat seed lots contain unacceptable levels of weed seeds. Farmers should have their seed cleaned at certified seed conditioners. Using trashy wheat seed not only increases the weediness of a field, but also reduces the seeding rate, resulting in a lower wheat population and a less competitive stand of wheat. Seed treatments should be considered to control seedling diseases.

Seeding Date

It is important to plant winter wheat during the optimum planting time *(Figure 3)*. For example, at North Platte the optimum seeding period is September 15 to 25. Planting wheat earlier than the optimum seeding date may result in lower winter wheat yield because the wheat will be more vulnerable to crown and root rot infection *(Table III)*. Additionally, weeds are more prevalent in wheat that is seeded before the optimum date. Even the following summer crop, for example grain sorghum *(Table III)*, was found to have more weeds when it was planted into early seeded winter wheat residues rather than winter wheat seeded near the optimum time. Winter wheat seeded too late may not tiller enough to suppress weeds in the spring and yield may be reduced.

Seeding Rate

Seeding rates can be adjusted to improve weed control. In Nebraska, winter wheat is planted at 45 to 120 lb/ac, depending on location and planting date. The 45 lb/ac rate is more common in western Nebraska while 60 to 75 lb/ac is more common in the eastern two-thirds of the state. When winter wheat is planted at the optimum time, the appropriate seeding rate is 18 seeds per foot of row. This is about 60 lb/ac with average seed size. Planting fewer seeds may result in increased weed growth. Generally, seeding rates need to be increased when seeding is delayed beyond the optimum dates to compensate for reduced tillering. Higher seeding rates are used when winter wheat is planted late, such as after soybean harvest, or when wheat is irrigated.

Row Spacing

Winter wheat is planted in row widths from 6 to 14 inches in Nebraska. Generally row spacings are wider in west central and western Nebraska. Wide rows are advantageous when soil moisture is limited because hoe openers can move dry soil to the interrow without excessive seed coverage. The wheat seeds then are placed into firm moist soil, thereby improving wheat germination, seedling vigor, and crop competitiveness with weeds. However, when moisture is not a limiting factor, narrow rows and increased crop density offer advantages for weed control *(Figure 4)*. The ground is shaded sooner in narrow rows and weed development is suppressed. Narrow row spacing can improve weed control during the fallow periods because weeds are smaller and more easily controlled with herbicides than they are in wide row spacings.

Table III. Effect of winter wheat planting date on density of summer annual grasses in wheat and the following grain sorghum crop at North Platte.[1]

		Summer annual grasses	
Planting date	*Winter wheat*	*In wheat*	*In sorghum*
	bu/ac	—— number/meter^2 ——	
September 1	18	14	270
September 15	37	7	140
September 25	39	8	100
LSD (5%)	5	5	120

[1]Adapted from Wicks et al., Weed Science 43:434-444.

Row Direction

Row direction may influence weed densities *(Table IV)*. In fields where rows ran in a north-south direction, weed control following wheat harvest was better than where rows ran in an east-west direction. It is hypothesized that the north-south rows shade the ground better than east-west rows and reduce weed emergence. In fields where soil erosion is not a concern, north-south rows are preferred.

Table IV. Effect of row direction on weed density when an 11- to 14-month fallow period precedes winter wheat.[1,2]

Direction of rows	*Stinkgrass*	*Tumble pigweed*
	—— number/meter^2 ——	
North-south	0.8b	0.3b
East-west	4.5a	1.7a

[1]Adapted from Wicks et al., Weed Technology 17:467-474.
[2]Numbers in columns followed by the same letter are not significantly different at the 5 percent level.

Seeding Wheat

Depth of soil over the seed should be 1 to 1.5 inches in medium to fine textured soils and 2 inches in coarse textured soils. If one must seed deeper to reach soil moisture, a long coleoptile wheat variety must be used. Never cover the wheat with more than 3 inches of soil. If the top 2 to 4 inches of soil

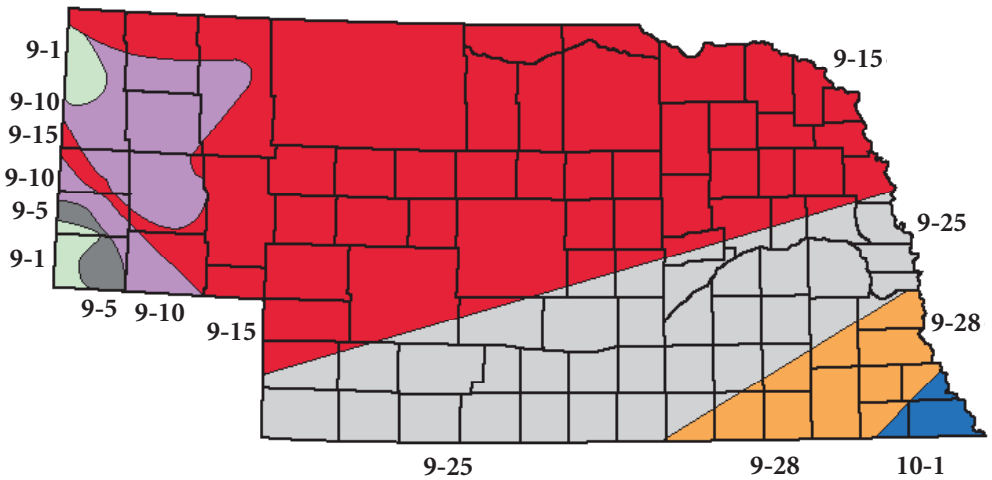

Figure 3. Guide for optimum planting date for winter wheat in Nebraska. Adapted from EC103, *Nebraska Fall-Sown Small Grain Variety Tests.* Window ends about 10 days after the optimum date.

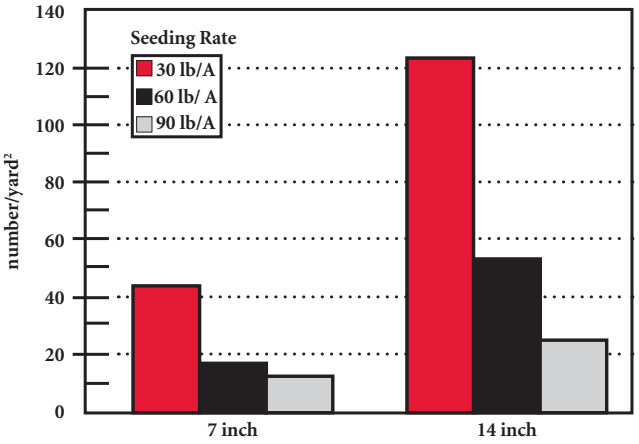

Figure 4. Summer annual weed density five days after winter wheat harvest is affected by row spacing and wheat seeding rate. Adapted from *Agronomy Journal* 75:507-511.

are dry at planting, a hoe drill is preferred over a disk drill to place the winter wheat seeds into firm moist soil. The openers must have proper tension to ensure the wheat is planted deep enough, especially in the tractor wheel tracks. Weed density is often greater in wheel tracks because the wheat does not emerge well due to improper seeding depth.

Soil Fertility

A good fertilizer program based on soil tests and appropriate application timing will increase the vigor and competitiveness of the winter wheat crop. In general, weed control is better when nitrogen is applied in the fall rather than in the spring *(Table V)*. Fall fertilization improves the competitiveness of winter wheat and reduces summer annual weed growth; however, fall-applied nitrogen is more susceptible to leaching than spring-applied nitrogen, especially in eastern Nebraska.

Table V. Effect of fertilizer application timing on wheat yield, tiller density, and weed density in three regions of Nebraska.[1,2]

Timing of fertilization	*Wheat yield*	*Tiller density*	*Weed density*
	bu/ac	number/meter²	
Western region			
Fall	60a	650a	4.2b
Spring	59a	660a	7.5a
South-central region			
Fall	62a	610a	0.5b
Spring	51b	410b	4.4a
Southeastern region			
Fall	59a	630a	8.2a
Spring	43b	470b	15.9a

[1]Adapted from Wicks et al., Weed Technology 17:467-474.
[2]Within a region, numbers in columns followed by the same letter are not significantly different at the 5 percent level.

When nitrogen is applied in the spring, it requires adequate and timely rain to move the nitrogen into the root zone. If rainfall is not adequate and timely, late germinating weeds can take advantage of the nitrogen. Weeds may be larger after harvest and more difficult to control where nitrogen was applied late in the spring. The excess weed growth is due to wheat's incomplete utilization of nitrogen as a result of the late application. Spring nitrogen applications are best applied as early in the spring as possible. Do not wait until the optimum time for herbicide application to apply nitrogen or some of the potential yield benefits will be lost. When nitrogen is to be applied in spring, band phosphorus at planting to stimulate crop growth.

Fertilizer placement is very important with phosphorus. Phosphorus applied as a band when wheat is seeded can increase wheat yield and reduce weed density after wheat harvest *(Table VI)*. Row-applied phosphorus is very beneficial to wheat seeded after the optimum planting date, even for soils containing high levels of phosphorus. *Never* put ammonium thiosulfate (12-0-0-26) with the seed.

Table VI. Influence of phosphorus on winter wheat yield, stem density, and weed density when banded in a farmer's field at winter wheat seeding time in west central Nebraska.[1]

	Phosphorus	
Item	*No*	*Yes*
Winter wheat yield (bu/ac)	48.0	58.0
Winter wheat stems/m²	600	730
Witchgrass/m²	2.0	0.0
Stinkgrass/m²	4.3	0.3
Pigweed/m²	2.7	0.0
Russian thistle/m²	0.3	0.3
Common purslane/m²	1.0	0.0
Total weeds/m²	10.3	0.6

[1]Adapted from Wicks et al., Weed Technology 3:244-254.

In-Crop Weed Control

Fields should be checked for weeds four to six weeks after planting and in February through April for broadleaf weeds. See UNL Extension EC130, *Nebraska Guide for Weed Management*, for details on using herbicides to control broadleaf weeds in winter wheat. Broadleaf weed problems encountered in the stubble after winter wheat harvest can be largely eliminated by a timely spring herbicide application in the growing winter wheat.

Conclusion

Weed control in winter wheat requires an integrated system that relies on numerous management decisions related to maximizing crop growth and minimizing weed growth. The use of multiple cultural practices for weed control frequently provides synergistic benefits greater than the added effects of using just one or two cultural practices. Timely field scouting is essential in good weed management.

Acknowledgment

We acknowledge the significant contributions to this NebGuide made by Gail Wicks, former Extension Weed Specialist at the West Central Research and Extension Center at North Platte, Nebraska.

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