Wheat is unique in the southern Great Plains in that producers use it very flexibly for either forage, forage and grain, or grain alone (Figure 1). When using wheat for forage, it may be grazed full season, harvested for hay or silage, or grazed just during the vegetative growth stage. Frequently, producers will decide whether or not wheat will be grazed full season shortly before or at the early joint stage. This permits flexibility in response to changes in cattle or grain prices, weather, and federal farm programs.

Producing abundant wheat forage requires timely management operations as well as cooperation from the weather. This publication focuses on management aspects as they relate to maximizing potential returns from grazing. Operations that influence grazing include:

- **Seedbed Preparation**
- **Variety Selection**
- **Fertilization**
- **Planting**
- **Weed control**

**Seedbed Preparation**

The seedbed should be prepared several weeks prior to planting. One exception to this would be where soil surface roughness is required to prevent wind erosion. The best seedbed is free of weeds and volunteer wheat, firm enough to be able to control seeding depth effectively, moist enough for quick germination, and friable enough so seed is covered uniformly with soil behind the seed opener. Such a seedbed may be obtained with minimum or conventional tillage systems. Tillage is not needed in most situations except for weed control, wind erosion control, or alleviation of soil compaction. Most producers believe at least one of these factors exists and do not grow wheat in a no-tillage system. Assuming tillage is performed, frequently the best way to obtain an optimum seedbed is to plan for one very shallow (1-2 inches) tillage operation immediately prior to the planting operation or as part of the planting operation. Preferably rain will have firmed the soil before the final tillage operation and seeding. Tilling too deep with the last tillage operation leaves the seedbed too soft, resulting in great difficulty controlling seeding depth.

Water stress is one of the primary limitations in fall forage production. Therefore, conserving as much soil moisture as possible from harvest to seeding is important. Soil moisture is lost by two methods. First, it evaporates from the soil surface. Maintaining either a crop residue or dust mulch on the soil surface reduces the rate of evaporation from the surface. Generally, the soil will dry out as deep as the most recent tillage operation. Consequently, deep tillage throughout the summer is not desirable from a moisture conservation perspective. Second, soil moisture is lost as plants transpire. Any plants, whether weeds or volunteer wheat, use up soil moisture very quickly during the hot, windy summer months. A few weeds can quickly use all the soil moisture stored in the rooting depth. To limit the amount of soil moisture lost during the summer, the deep tillage, if done at all, should be done as soon as possible after harvest and should kill any weeds present. Since anhydrous application tills the soil and requires relatively deep placement (4-6 inches), it should be applied early in the summer rather than shortly before planting. Weeds which germinate through the summer should be killed by herbicide or shallow tillage before the grasses begin tillering or before broadleaves begin branching. This shallow tillage is also very effective in reestablishing a dust mulch to reduce evaporation.

**Variety Selection**

Quantity of forage, ratio of fall production to total forage, and length of spring grazing season are all influenced by variety selection. Producers need to prioritize their needs and select varieties based on these priorities. No single variety fits all producers’ priorities equally well.
Fertilization

Many of the soils where wheat has been grown for many years need lime, phosphorus, and nitrogen. Potassium deficiencies may also occur in some areas of Oklahoma. Soil testing is the only accurate method to determine needs for each nutrient and is the most reliable guide to developing an economical fertilization strategy. Quantities of available nitrogen in the soil change rapidly, depending primarily upon the amount of nitrogen added relative to the amount removed in forage and/or grain harvest. Soil needs to be sampled to 24 inches to obtain an adequate estimate of residual nitrogen. Phosphorus and potassium recommendations from the soil test are for annual applications and do not change or need adjustment in relation to yields. Lime recommendations are based on correcting a low pH situation for at least the next three to five years.

For most wheat soils, all fertilizer needed for a given wheat crop can be applied prior to or with the planting operation. Deep sandy soils with a high leaching potential should have nitrogen applied as the crop needs it, rather than applying all the nitrogen prior to planting. Nitrogen requirements can be calculated based on projected forage yield, assuming that each 1,000 pounds of dry forage requires 30 pounds of nitrogen. Projected grain yield will require an additional two pounds of nitrogen for each bushel of grain. To calculate the total amount of nitrogen to be applied, the amount of nitrogen available in the soil based on the soil test result is subtracted from the quantity needed to produce the projected forage or forage and grain yield goals. Frequently, producers apply enough nitrogen for a moderate yield goal, and then recalculate in January to determine if additional nitrogen is needed. Soil tests taken after the wheat is growing are not helpful in evaluating nitrogen needs because nitrogen already in the plant and that which is temporarily tied-up in microbial tissue cannot be accounted for. At the time of topdressing, producers seldom know how many pounds of dry forage were produced, but nitrogen removed by cattle can be estimated by assuming that each 400-500 pound steer removes 15 pounds of nitrogen per month. Therefore, the number of steers per acre multiplied by number of months grazed multiplied by 15, equals pounds of nitrogen removed. For example, at two acres per steer for five months, the formula is 0.5 X 5.0 X 15 = 37.5 lbs N/A.

Soil pH below 5.0 will reduce forage production more severely than it will reduce grain yields. Figure 2 is an example of low pH effect on most wheat varieties. Since the plow layer has the lowest pH, the roots of wheat seedlings are immediately trying to grow into soil with low pH and excess aluminum. Therefore, fall forage yield is reduced because plants are trying to produce forage while the roots are inhibited while growing through the low pH soil. As soil pH drops from 5.0 to 4.5 or lower, forage produced prior to early December can be reduced by 85% as shown in Figure 3 for Chisholm and Karl. There are a few varieties like 2180 and 2163 which are much more tolerant to low pH. Note that even with these varieties there is still a yield reduction. After a period of time, some of the roots grow through the low pH surface soil into higher pH soil below the plow layer. Since grain yield is primarily determined in late winter and spring, the roots may have grown through the low pH soil into more favorable conditions.

Figure 2. Liming and low pH effect on wheat.

Figure 3. Fall forage production for wheat varieties differing in sensitivity to low soil pH.
before the critical stage for grain yield determination. Soil pH should be maintained above 5.0, and lime should be used to correct low pH and prevent it from limiting production.

Placing 30 to 60 pounds of phosphorus in the seed furrow can temporarily reduce unfavorable high aluminum conditions and increase forage production soon after planting, regardless of soil test levels of phosphorus in very acid (pH less than 5.0) soil. This can be accomplished with diammonium phosphate (18-46-0), a dry fertilizer, or ammonium polyphosphate (10-34-0), a liquid. If soil pH is not low or is only marginal, the benefit of some phosphorus applied in the seed furrow may still be realized.

**Planting**

Wheat for forage can be planted as early as mid-August and as late as December. For maximum fall and early winter forage, late August or early September planting is recommended. Forage production potential may be reduced by 1,000 pounds per acre for each two week delay in emergence during August and September. This potential yield would be reduced by any drought stress during the fall growing period. Such drought stress frequently occurs for early planted wheat. Figure 4 summarizes forage yield data collected over two years at Lahoma and Perkins showing the effect of planting date and seeding rate on wheat forage produced prior to the early joint stage of growth. An October 15 planting date was also included in this study, but there was not enough forage to make a clipping before January. Note that the ideal planting time for wheat grown for grain only is between September 20 and October 20; therefore, planting before September 20 may result in higher forage yields and reduced grain yields.

When wheat is overseeded into a summer forage, planting should not be done until the summer species is entering dormancy and has been grazed close. No fall or winter grazing should be expected from the wheat overseeded into a summer forage.

Seeding rate, depth, and row width all influence early season forage production. As noted in Figure 4, seeding rates as high as 180 pounds per acre (3,000,000 seeds per acre) increased forage production prior to the early joint stage of the wheat. However, the highest seeding rates may not be economical, depending upon the seed cost. Producers placing a premium on fall forage should plant at least 2 bu/acre and obtain 22 plants per row foot when planting in seven-inch rows. See Table 1 for other row width and seeding rate combinations.

Row width is much more important in early forage production than later in the season. Planting in narrow rows helps desired plants to be more competitive with undesirable plants. Rows as narrow as three inches can increase early forage yield simply because the plants are more equally spaced, resulting in the ability to better use sunlight and other resources. Once wheat plants form a canopy over the row middles, row width is less important. Three inch spacing may not be mechanically practical at this time, but producers purchasing new drills should consider 6 or 7 inch rows if they have been planting wider rows.

Planting depth is important at all times of the year, but is extremely important when planting in hot soils (above 85°F at seeding depth) in August and September. The high soil temperatures cause the protective covering over the first leaf (the coleoptile) to be shorter than normal (less than 1.25 inches in 100°F soils). If the coleoptile does not elongate enough to reach the soil surface, the plant seldom emerges, especially if it rains between planting and emergence. Therefore, wheat seeded early in hot soil should be seeded no deeper than one inch or stand reductions are likely. When seeding in late September or October, seeding depths of one to two inches produce good results. We recently surveyed wheat stands and found that in about one-half of the wheat fields 50% or less of the live seed planted had emerged within two weeks of planting. The primary reason is believed to be

![Figure 4: Effect of planting date and seeding rate on wheat forage produced prior to the early joint stage of growth.](chart)

**Table 1. Seeds and plants per row foot for different seeding rates and row widths.**

<table>
<thead>
<tr>
<th>Row width (inches)</th>
<th>Seeding rate 60 lb/acre</th>
<th>Seeding rate 90 lb/acre</th>
<th>Seeding rate 120 lb/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Seeds¹</td>
<td>Plants²</td>
<td>Seeds¹</td>
</tr>
<tr>
<td>6</td>
<td>11</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>7</td>
<td>13</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>15</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>9</td>
<td>17</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>10</td>
<td>19</td>
<td>15</td>
<td>29</td>
</tr>
</tbody>
</table>

¹ Assumes 16,670 seeds per pound or 1,000,000 seeds per bushel.
² Assumes that 80% of the seeds produced plants.
seed being placed too deep for the coleoptile to reach the soil surface. There may be many reasons for the seed to be too deep, but a soft seedbed where depth control is difficult is a common observance. One suggestion to overcome this is to prepare the seedbed well in advance of the projected planting date, expecting a good rain to firm the soil before planting. Follow this as close to planting as possible with a shallow tillage operation, destroying any existing weeds or volunteer wheat and preparing a friable seedbed. We are primarily interested in having a firm seedbed where it is easier to control seeding depth as well as conserving moisture.

**Weed Management**

Weeds use soil moisture and nutrients which are critical for forage production. They compete for sunlight needed for photosynthesis and produce seeds contaminating the soil for future years. Just a few weeds during the windy, hot summers can use up any soil moisture left from the previous crop. Therefore, keeping fields nearly weed free during the summer is important.

Weeds in the wheat crop are sometimes ignored because they are considered useable forage. However, these weeds may not be as palatable to cattle, and therefore may gain an advantage over nearby grazed wheat plants. Wheat is an extremely high quality forage, and many of the weed species will be lower in quality. There are several herbicides available for weed control, and details can be found in OSU Fact Sheet 2770.

Grazing wheat provides a very effective opportunity for controlling cool season weeds such as cheat, which is difficult to control with herbicides. A tillage operation or herbicide application to kill these weeds immediately after cattle are removed from the wheat pasture will prevent them from producing seed to infest the next wheat crop. Waiting just a few days after removing the cattle to spray or till may allow enough time for viable seed production to occur. Rains occur frequently in May as the grazedout is terminated and a rain soon after tillage can reduce the effectiveness of tillage in killing the weeds and preventing seed production.

**Grazing**

Grazing should not be initiated until wheat has developed a coronal root system (frequently called secondary root system). The coronal root system anchors the wheat plant, making it difficult for cattle to pull it up. Furthermore, leaf removal at this growth stage is not as critical to future growth. The coronal roots are those which originate at the crown in contrast to primary roots which originate at the seed. Figure 5 is a five week old wheat seedling. The seed was attached near where zero is on the ruler and the primary roots developed from this point. About 1.5 inches above the seed, the crown formed in this plant. In this figure one cornal root grew, but three additional cornal roots started but never grew out. Cornal roots begin to emerge at the same time that tillers emerge. If the soil is dry where the cornal roots are forming, they will stop growing until the soil is moistened. Therefore, if no rain has fallen from planting until cornal roots begin to develop, they probably will not penetrate the soil until a rain does occur. Cattle should not be pastured until cornal roots have grown out.

Grazing before the wheat plant has several tillers is detrimental because wheat growth is a relatively slow process from germination until tillering occurs. Removal of the early leaves will slow the growth rate, resulting in less dry matter production by December 1. Wheat growth and accumulation in September through November is needed if dependable grazing is to be available for the December through February period when the wheat is growing slowly. Once daytime temperatures fall below 60° F or nighttime temperatures below freezing, wheat growth is very slow. Rapid growth resumes in late January or February as temperatures warm again.

**Stocking Density**

Dry matter accumulation in wheat pasture can be estimated visually. Wheat forage about six inches high contains between 500 and 750 pounds of dry matter per acre. In Figure 6 the lower white marking on the board is six inches, and 750 pounds of dry matter were harvested from this plot. Row width and the growth habit of the variety will influence these estimates. Even though these are only estimates, they should help you to determine the stocking rate (acres per animal) and to estimate how long the forage supply might last. Table 2 provides daily consumption values.
Table 2. Forage Dry Matter Needed/Animal/Day.

<table>
<thead>
<tr>
<th></th>
<th>Calves*</th>
<th></th>
<th>Cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 lb</td>
<td>12 lbs.</td>
<td>Wet</td>
<td>30 lbs.</td>
</tr>
<tr>
<td>400 lb</td>
<td>14 lbs.</td>
<td>Dry</td>
<td>25 lbs.</td>
</tr>
<tr>
<td>500 lb</td>
<td>17 lbs.</td>
<td>Bull</td>
<td>32 lbs.</td>
</tr>
<tr>
<td>600 lb</td>
<td>19 lbs.</td>
<td>Horse</td>
<td>32 lbs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sheep</td>
<td>5 lbs.</td>
</tr>
</tbody>
</table>

*Considers growth and increased consumption over 180 days.
From FS-2584, Forage Planning Guidelines.

Rotational Grazing

Rotational grazing is beneficial and can be achieved with two or three electric fences within the wheat pasture. The rotation is very useful in the fall, enabling the operator to recognize a situation of too many cattle for the amount of forage available. Early recognition of such a problem provides more time to develop contingency plans of feeding either high quality hay, feeding a concentrate, or reducing stocking rates. There is no evidence that rotational grazing will improve carrying capacity for fall grazing, but the rotation can improve spring carrying capacity by up to 20%. More complete utilization of the grazed area is the biggest benefit of rotational grazing. As the spring growth occurs, close grazing dramatically reduces the plant’s capability to continue producing forage. Thus, with rotational grazing the area not being grazed as jointing occurs has the opportunity to produce abundant forage.

Grazing Termination

If grain harvest is desired, grazing should be terminated immediately when the stems begin to elongate (first hollow stem growth stage). Figures 7, 8, and 9 illustrate wheat stems cut off just above the root and cut in half longitudinally. Figure 7 has no hollow stem and the growing point is just above the roots. Above the growing point are rolled leaves and leaf sheathes. Jointing has not begun. Figure 8 has about one quarter of an inch of hollow stem. This represents the first hollow stem growth stage or the earliest stage of jointing. Figure 9 has considerable stem elongation and the growing point (head) would probably be at or above the soil surface. The first hollow stem stage of growth must be determined in ungrazed wheat of the same variety and planting date as the wheat being grazed, since the stem will not elongate in heavily grazed wheat. This elongation generally occurs in central Oklahoma between March 1 and March 20. Even though stem elongation is not occurring in the grazed wheat, allowing cattle to graze one week after the stem begins elongation in similar ungrazed wheat can reduce grain yields as much as an average of two bu/acre per day during the first week. Figure 10 summarizes data showing how rapidly the net return to a stocker-grain enterprise declines when cattle graze the wheat pasture too long.

Wheat Hay and Silage

High quality wheat hay should be harvested as the heads first begin to emerge. This hay makes an excellent forage for either bad weather emergency feeding or to provide additional forage where the stocking rate on wheat pasture appears to be too high for the available forage. The quality of the hay declines rapidly as wheat matures beyond the early heading stage. There is a tendency to delay harvest because of the desire for higher yields, but the value per acre will decline even though yields increase. Wheat for silage should be harvested when the wheat is in the soft dough stage. Such silage should be about 10% crude protein.
Insect Control

The primary insects of concern in wheat for forage are the greenbug and the Russian wheat aphid. Both of these aphids have a major impact on wheat forage yield, and they need to be monitored very carefully. Russian wheat aphid has been a problem only in the western counties, but is a very severe pest where it occurs. Only 10 to 20 greenbugs can kill two to four leaf wheat. Even lesser numbers will reduce forage yields because greenbugs inject a toxin into the plant which reduces root and stem growth. Growers should consult OSU Fact Sheets 7176 and 7183 for characteristics of these aphids. Control measures and threshold levels are available from these references.

There are other insects of concern in wheat, but they are not a consistent problem like the aphids. Army cutworms occur occasionally in the late winter and early spring, and damage the wheat by eating leaves and stems. Grasshoppers can occasionally create a problem in early fall planted wheat.

Diseases

The two diseases of concern in wheat grown for forage are wheat streak mosaic virus and soilborne mosaic virus. Wheat streak mosaic virus is transmitted by the wheat curl mite. None of our current wheat varieties are resistant; therefore, the only way to reduce this disease is prevention. Prevention of wheat streak mosaic virus depends on eliminating wheat curl mites from wheat fields prior to planting. Eliminating all volunteer wheat in your fields and neighboring fields by killing it with a herbicide or tillage at least two weeks prior to planting the earliest wheat is the best way to prevent wheat curl mites from infesting the new wheat crop. Wheat streak mosaic virus will reduce forage production from the time of infection until maturity, with the greatest effect occurring after jointing has begun.

Soilborne mosaic virus is much different. This virus is present in the soil and can survive in the soil for many years. Excellent varietal resistance to soilborne mosaic virus is available. Wheat fields with a history of this disease should only be planted with resistant varieties. Soilborne mosaic virus reduces wheat forage production most during late winter and early spring when weather is cool and wet. Once the soils warm and wheat begins rapid growth, the effect of this disease seems to disappear. However, severe reductions in forage production may have already occurred. For more information on these diseases, see OSU Fact Sheets 7629 and 7636.

Other Small Grains for Pasture

If contamination of a field with other small grains is not considered a problem, other species may allow flexibility.

Rye—will often grow more than wheat in the late fall and winter because of its ability to grow at lower temperatures than wheat. Rye varieties are also tall, have much longer coleoptiles than most current wheat varieties, and produce good stands when planted deeper in hot soils. However, rye may be a volunteer problem for several years after it was planted. Rye forage production decreases more rapidly in the spring than wheat.

Oats—can make excellent fall growth, but winterkilling is frequently a problem with many varieties. A hard freeze usually kills the top growth and ruptures the cell walls. Subsequent rainfall leaches nutrients from these ruptured cells and causes considerable reduction in forage quality. Depending on the severity of the freeze and susceptibility of the variety, such freezes may kill all plants and no regrowth occurs in the spring, or may kill all but the growing points and slow regrowth may occur in the spring.

Barley—also has some of the winterhardness problems of oats, but can be a good winter forage. Barley would be the best choice for salty, or saline, soil problems.

Annual ryegrass—mixed with any of the small grains will extend the spring graze-out period by two to three weeks if soil moisture is available through May. It will reseed itself and become a very serious weed in future grain crops, just like cheat.

Legume - small grain mixtures—such as hairy vetch or arrowleaf clover grown with small grains can extend the spring grazing season in areas where they are adapted. Small seeded legumes should not be planted as deep as the small grains. Care needs to be taken to get the appropriate seeding depth for both species. The legumes have hard seed which remain viable for years and they can become a weed problem.

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