Incorporating Annual Forages into Crop-Forage-Livestock Systems

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Introduction

Annual forages have been used in warm-season and cool-season perennial grass forage systems to successfully to extend the grazing season for beef production systems. They are used to increase the forage production potential per acre, and reduce the need to rent or purchase pasture, and to modify or expand livestock production systems. While it is readily apparent of the potential forage production in annual-only forage systems, it is less apparent when incorporating annual forages into grain cropping systems **(Table 1)**. There is little information on using small grains on using small grains and other cool-season annuals as forage sources for integrated crop-forage-livestock systems.

Table 1. Forage production potential for annual double-crop forages following grain production. The solid segments represent typical growing season for various grain crop and annual forage species.

System	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Crops												
Corn	**Residue**										**Residue**	
Soybean												
Cool-season annuals(small grains and brassicas)												
Fall only												
Fall/Spring												
Spring only												
Brassicas												
Warm-season annuals												
Sorghums, millets												

The primary advantage for considering these systems is to provide an additional use for cropland outside of the traditional growing season. Including annual forages into cropping systems has the distinct advantage of providing a readily available source of high-quality grazing. These can be used to provide alternative grazing options, extend the grazing season, increase dollar return per acre, and intensify management. However, it is important to understand risks and limitations of including annual forages into existing cropping systems.

Small grains as forage

The major small grains used as forage are oats, cereal rye, triticale, and wheat. Late summer into early fall is a good time to plant small grains for forage. Not all small grain species are equal when it comes to forage production. Many species and varieties are referred to as winter sensitive (spring types) or winter hardy. Often, these designations are true only for the region where they were selected and developed. For example, a winter-hardy species developed in the southern US may or may not survive extended colder temperatures common in the central U.S. Likewise, a winter-hardy variety may not survive in the region where it was developed due to climate extremes.

Typically, fall forage yield for small grain forages is negatively correlated with winter hardiness. This means that oats and winter sensitive (spring) varieties of triticale, wheat, and barley may yield more in the fall than cereal rye or winter-hardy varieties of triticale, wheat, or barley. In terms of fall forage production, small grain forages planted from mid-August through early September are highly digestible, with energy values ranging from 60 to 75%. Crude protein will vary from 10 to 20%, depending on the amount of N available for plant uptake (Drewnoski and Redfearn, 2015).

Oats is one of the more widely used forages for fall and spring production. However, it nearly always fails to survive cold temperatures in the central and northern Great Plains and must be planted again during late winter for spring production. Oats are commonly classified as either "grain-type" or "forage-type." More often than not, this designation is based on maturity and plant height rather than intended use. Grain-type oats have an early to medium maturity with a short to medium plant height. In contrast, forage-type oats have medium to late maturity that is taller at maturity. Under reasonable growing conditions, both types will produce adequate forage for either fall or spring grazing.

For spring growth, cereal rye has the advantage that it matures earlier than either triticale or wheat. If grazing or harvesting is planned prior to mid-May, it is likely that cereal rye will produce greater yields. However, for forage production after mid-May, triticale may produce greater yields. However, cereal rye has become a weed in many wheat-producing areas, with a resulting reduction in grain yield and quality. Thus, it is not suitable as a forage crop where wheat is produced.

In the spring, nutritional value of small grain forages declines and forage yield increases as the plant matures. When small grain forages are in the boot stage with the seedhead still enclosed within the sheath of the flag leaf, total digestible nutrients (TDN) ranges from 70 to 80%. However, by early dough stage the TDN will have decreased to 50 to 60%.

Triticale and barley have shown some promise as double-crop forages. However, they have not been evaluated as extensively as cereal rye or wheat. Triticale is a cool-season annual that is actually a cross of wheat and cereal rye. Currently, its primary use is as a second crop in irrigated production systems, and it is planted on sandy soils in the fall after corn or soybean harvest. This provides a cover crop to meet conservation compliance on the sandy soils, and provides quality forage during winter and spring. The forage is grazed or harvested by spring

before planting another annual summer grain crop, resulting in three crops being harvested in two years.

Fall grazing management

Typically, 40 to 60 days growth is needed to produce sufficient growth for grazing of cool-season annuals. Thus, fall grazing can usually begin in early October when grazing double-cropped cool-season annuals planted by mid-August. However, grazing can be delayed until late October or early November. This will allow for increased forage production and will not result in extensive loss of quality.

Spring grazing management

Winter-hardy species such as cereal rye or winter triticale can be lightly grazed when fall growth reaches 6 inches or greater. If spring grazing is desired, cattle should be removed when the forage height is reduced to 4 inches. Spring grazing can begin when the grasses are 6 to 8 inches tall. To provide rapid regrowth, cattle should be removed when stubble reaches 4 inches to maintain sufficient leaf area for growth and recovery.

Development of integrated crop-forage-livestock systems

From a forage management standpoint, annual forages offer great flexibility for forage production. Species can be selected to fit any number of production objectives. However, the risks and trade-offs associated with this increased flexibility are also increased. Therefore, it is important to understand both the positives and negatives associated with incorporating annual forages into cropping systems.

In grain cropping systems, there are long periods of time that are lost to potential forage production. After corn, for example, there is minimal possibility to produce a forage double-crop following the long season hybrids (> 100-day hybrids) prior to planting the next crop–the exception being some spring grazing of a winter-hardy small grain planted following residue removal. The major tradeoff for growing a cover crop to produce forage would be delayed planting of the subsequent grain crop. The possibility exists for forage double-crop grazing growing a short-season corn hybrid (85-day). The major tradeoff in switching some of the acres to a short season hybrid is reduced grain yield versus potential increased forage production. Additionally, residue harvest, preferably as baling, would be required.

Forage double-crop options following soybean

Other grain crops offer easier opportunities for forage production. Following soybean, the choice of a forage double-crop is limited to winter-hardy small grain forage species such as cereal rye or triticale. To increase the probability of grazing the forage double-crop following soybean, it may be necessary to select an earlier maturity group soybean. Again, the tradeoff with this is reduced grain yield versus potential increased forage production.

When planting a forage double-crop following soybean harvest, it is unlikely that adequate growing degree days remain to produce any appreciable amount of fall forage. Planting a winter-

hardy species such as cereal rye or winter triticale in the fall can result in greater spring forage production than spring planting.

A three-year grazing trial that compared 'Millenium' winter wheat, 'Elbon' cereal rye, and 'NE422T' triticale was conducted near Mead, NE (R.B. Mitchell, unpublished data). Small grains were no-till seeded into soybean stubble following fall harvest and grazed the following spring. Pastures were fertilized with 60 lbs N/acre in the autumn prior to planting. Each pasture was continuously stocked with four yearling steers 17, 32, and 28 days in 2005, 2006, and 2007, respectively.

It is important to note that no forage provided superior steer performance across all years. In 2005, ADG for cereal rye exceeded ADG for triticale and wheat by an additional 1.0 to 1.7 pounds per head per day. In 2006, ADG for wheat exceeded ADG for triticale and cereal rye by 0.3 to 1.3 pounds per head per day. In 2007, steers grazing wheat and cereal rye lost weight, while steers grazing triticale gained 0.4 pounds per head per day. The data from this trial suggests that triticale may provide the most stable performance across years.

Forage double-crop options following winter wheat

The ability to produce forage following winter wheat offers increased flexibility for growing double-crop forages. In the western Corn Belt, wheat is harvested by mid-July and can provide an additional growing season until the first killing freeze in areas. This offers two options for producing a double-crop forage. Currently, planting summer annual forages prior to August 1 and planting winter annuals after August 1 following winter wheat seems to offer a balance for reducing production risks between warm-season and cool-season annual forage crops.

The potential exists for either a late-summer planted, summer annual forage or an early-planted, winter annual forage. After grazing, additional termination of the double-crop forage the following spring prior to corn planting can be either through winterkill for winter-sensitive species or herbicide application for the more winter-hardy species.

Currently, mixtures of oats and brassicas are commonly planted following wheat production in the higher rainfall areas of eastern Nebraska. There are several advantages to these mixtures. They are both easy to establish and have rapid growth and high quality. These mixtures can provide abundant high-quality forage for fall grazing **(Table 2)**. From a management standpoint, they both winterkill and do not require termination prior to planting corn the following spring.

Table 2. Forage yield of 'Purple top' turnip, 'Daikon' oilseed radish, and oats planted as mixture in early August following wheat in southeastern Nebraska. Numbers in parentheses are portions of contribution toward total.

Species	Above-ground	Below-ground	Total
	---------- pounds/acre ----------		
Turnip	1053 (.66)	549 (.34)	1602
Radish	1253 (.72)	490 (.28)	1743
Oats	1189 (1.0)	--	1189
Total	3495 (.77)	1039 (.23)	4534

Largely, the above-ground biomass over 1½ tons per acre and was composed of near equal totals of turnip, radish, and oats. The below-ground biomass production of the brassicas was roughly ½ of their leaf production. Total biomass production for the mixture was greater than 2 tons per acre.

Importance of planting date

Fall forage production is determined by moisture availability and planting date. The risks and potential yield are well demonstrated by Holman et al. (2011) during a three-year evaluation of four winter wheat planting dates on fall and full-season forage production. In year one, there was no fall forage production regardless of planting date. During the other two years, fall forage averaged approximately 1½ tons/acre at the earliest planting date (August 25) with a yield decrease over 50% with each 7- to 10-day planting delay. Forage production the following spring was not dependent on early planting the previous fall.

Caution

It is important to pay close attention to herbicide labels when planning a double-crop forage following another crop. Even if annual crops are suitable for purposes other than grazing or haying, they must be managed as forage crops when making herbicide choices if that is the intended use.

Guidelines to success

For fall-sown small grains,

1. An early planting date is the most critical management factor.
2. Earlier maturing, but less winter-hardy varieties may provide more fall forage potential.
3. Later maturing, but more winter-hardy varieties may provide more spring forage production.

For spring-sown small grains,

1. Plant as early as possible.
2. Later maturing, tall varieties may provide more forage potential.
3. Small grains mature very quickly; harvest sooner rather than later to preserve high quality.

Summary

Ideally, planting a forage double-crop would occur as soon as possible following grain harvest, since the growing temperatures available for plant growth rapidly decline through the late summer into early fall. The risk of failure increases with later planting dates. However, establishment costs are often low enough for many of these forages that the successful years often outweigh the years in which a failure occurs.

References

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