# Stocker Cattle Performance from Grazed Mixtures of Triticale and Wheat with Ryegrass

by

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Abstract

Previous research indicates that beef production from winter-grazing in the lower Gulf Coast region is typically greater from monocultures of ryegrass (*Lolium multiflorum*) and wheat (*Triticum aestivum*) than triticale *(*× *Triticosecale*); however, little information is available on beef production from mixtures of these species. For this reason, we conducted a 2-yr experiment to evaluate triticale (T; var. 'Trical 2700'), wheat (W; var. 'SS 8641') and ryegrass (RG; var. 'Marshall') in mixtures as winter forage for grazing beef cattle. Replicate 1.42-ha paddocks of T + RG, W + RG and T + W + RG (2 paddocks/ treatment) were planted on November 30, 2012 (Yr 1) and November 4, 2013 (Yr 2), and were initially stocked with 4 yearling crossbred steers (mean initial BW, 357 kg) per paddock on January 29, 2013 (Yr 1) and December 16, 2013 (Yr 2). Forage allowance was maintained at a target value of 1 kg DM/kg steer BW utilizing an adjustable stocking density by the put-and-take method. Forage mass and nutritive value were determined by clipping eight 0.25-$m^2$ quadrats per paddock prior to grazing and at subsequent 2-wk intervals throughout the duration of the experiment. Grazing was discontinued in Yr 1 on May 24, 2013 (116 d) and in Yr 2 on May 5, 2014 (141 d) when forage mass and quality were no longer able to support an ADG 0.90 kg. Data were analyzed as a completely randomized design by the PROC

MIXED procedure of SAS 9.2, and forage metrics and chemical composition determined at each sampling period were treated as repeated measures. Suboptimal early-season growing conditions in Yr 2 contributed to decreased mean forage mass ($P < 0.001$) and stocking density ($P = 0.003$) compared with Yr 1. Across both yr, mean forage mass (1,093 kg DM/ha), forage allowance (0.89 kg DM/kg steer BW) and grazing-d/ha (375) did not differ ($P > 0.10$) among treatments, and there were no differences ($P > 0.10$) among treatments in steer ADG (1.45, 1.49 and 1.39 kg/d for T + RG, W + RG and T + W + RG, respectively). Mean forage IVDMD (90.9%) and concentrations of CP (19.5%) and ADL (1.2%) were not different ($P > 0.10$) among treatments. Results indicate that binary mixtures of W and T with RG were comparable, and the ternary mixture offered no advantage over binary mixtures, for beef production from winter-grazing of these forage species.

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# I. Literature Review

## Stocker Cattle Industry

### *Background*

The term “stocker cattle” was derived by people of montane origin who would purchase cattle in the spring to stock their lush mountain pastures. Over the years, this term has been used to describe a number of different types of cattle production systems ranging from growing cattle exclusively on cool-season pasture to the utilization of by-product feeds. However, the term has always referred to putting weight onto younger, lightweight cattle prior to shipment for finishing. Historically, the price of calves during the year is least in early autumn when the greatest number of calves is available (Ball et al., 2007). Prices for calves typically increase in winter and peak in March and April when these calves are typically sold. Depending on input costs in relation to calf prices, the stocker sector can potentially be profitable at all times of the year. Calves are no longer purchased only in the fall and sold in the spring, but are purchased throughout all times of the year. Over the last several years, the stocker industry has increased in both practice and profitability. The increase in grain prices coupled with all-time-low beef cattle numbers have increased the importance of increasing body weight prior to entering the feedlot. Beck et al. (2013) reported that the value of bodyweight gain for stocker calves has increased by 134% from 2000 to 2011.

With this new trend in beef cattle prices, the need for stockering cattle has increased and should continue to do so.

The stocker-cattle sector supplies the beef industry with many services that benefit and add value to the industry as a whole. Supplying the beef industry with immunocompetent feeder cattle is just one of the many services that the stocker industry provides. Also, the sector supplies feedlots with cattle that have been adapted to eat from a feed bunk and drink water from watering devices. Furthermore, the stocker industry provides greater opportunities to market cattle in groups, which increases sale price by up to 4% (Troxel and Barham, 2012). These services are well characterized and are needed to support the industry; however, the net returns are dependent upon the cost of production (Beck et al., 2012).

There are many factors that affect the profitability of the stocker industry. Most profitable producers in the stocker industry produce cattle that achieve a minimum of 0.9 kg ADG (Beck et al., 2013). Other factors that are vital to the stocker sector are carrying capacity, stocking rate and length of grazing season. All of these factors depend on the type of grazing system that is utilized. Keys to success in the stocker industry include intensive cattle and forage management.

*Southeastern Stocker Industry*

Hoveland (1986) has stated, "The greatest opportunity for improving profitability in Southeastern beef production lies in stockering weaned calves on high-quality, cool-season annual or perennial pastures." Although this quote is over two decades old, this ideology holds true and is even more relevant today. In the past, the Southeast has traditionally been a cow/calf region in which animals were sold at, or shortly after, weaning (Anderson et al., 2003). Because of its temperate climate, abundant forages and an extensive marketing infrastructure, the Southeast is well-suited for stocker cattle production (Anderson et al., 2003). The Southeast is an ideal location with abundant rainfall and mild temperatures that allow various types of systems to be implemented, which is favorable for stocker production throughout the entire year.

Stockering calves in the southern US has been an economically viable enterprise for many years. Evaluation of 37 grazing experiments indicated that the forage systems most likely to result in the least expensive cost of BW gain for stocker calves are based on high-quality, cool-season grasses (Prevatt et al., 2011). The cool-season grasses typically utilized in stocker operations are tall fescue (*Lolium arundinacea*), annual ryegrass (*Lolium multiflorum*) and small grains.

Tall Fescue is a commonly grown, cool-season perennial bunchgrass originally from Europe that has been established extensively throughout the US; however, endophyte (*Neotyphodium coenophialum*)-infected fescue generally produces low daily gains. Ball et al. (2007) reported that ADG of stocker cattle grazing endophyte-infected tall fescue averaged 0.57 kg compared with 0.86 kg for cattle grazing novel-endophyte tall fescue. If legumes are incorporated with tall fescue, cost of gain can be reduced and greater stocker gains can be achieved (Gunter and Beck, 2004).

Small grains and ryegrass are annual grasses that can produce high rates of gain in stocker cattle. Even though this forage system requires greater N input than a fescue and clover (*Trifolium* spp.) system, the stocker BW gains are great enough to offset the additional input cost (Rankins and Prevatt, 2012). Opportunity exists in the southeastern US for beef production from mixed pastures of ryegrass and small grains that differ in their individual growth patterns such that availability of high-quality forage is distributed more uniformly throughout the winter grazing season (Mullenix et al., 2012). Beck et al. (2007) evaluated various small grain and ryegrass combinations for stocker production and found that a combination of rye and ryegrass yielded the greatest BW gain compared with all other combinations, including ryegrass and small grains alone. In general, systems involving tall fescue required less annual input cost than cool-season annuals, but they generally yielded less production per ha than small-grain systems (Gunter and Beck, 2004).

**Small Grains**

Small grains are cool-season annual grasses that may be utilized for production of grain, forage or both. Small grains can be grown as forage to produce hay, silage, baleage, grazed pasture or a combination of the aforementioned. The main species that are planted in the US are wheat (*Triticum aestivum*), triticale (× *Triticosecale*), oat (*Avena sativa*), rye (*Secale cereale*) and barley (*Hordeum vulgare*). These species are typically planted in clean-tilled soil, but also are planted into warm-season sod. Small grains work exceptionally well in crop rotation with summer annuals such as corn (*Zea mays*), soybeans (*Glycine max*) or pearl millet (*Pennisetum glaucum*). Small grains typically are planted in late September to October and normally utilized from November to April. They work well because they have high nutritive quality and fill the seasonal forage gap following warm-season grasses.

*Triticale*

Triticale is a hybrid small grain that combines the genomes of wheat and rye. The first fertile hybrid dates back to the 1800s (Ammar, 2004). Triticale was first developed for grain in order to combine the quality and disease resistance characteristics of wheat with the hardiness and vigor associated with rye (Briggle, 1969). Varieties developed and released in the 1980s promoted some of the current-day triticale production in the southeastern US (Myers, 2009). To date, the majority of triticale production is planted for forage, animal feed grain or both (Mergoum and Gómez-Macpherspson, 2004). With the recent releases of forage-type varieties, a surge of planted acreage has occurred. The acreage planted nationwide in 2012 is estimated at 162,000 ha, and it is expected to increase significantly in the near future (Blount et al., 2012).

The nutritive value of triticale forage varies significantly among varieties and planting locations. Although there are limited data on the nutritive value of triticale grown as forage, the literature indicates that it is similar to that of other small grains and ryegrass (Blount et al., 2012). Brown and Almodares (1976) reported that percentage CP in triticale forage was similar to that in rye, wheat and oat at comparable stages of growth. Moral et al. (1995) reported an average CP concentration of 22.1% that ranged from 18.5 to 26.1% CP across 4 harvest dates. Bishnoi and Hughes (1978) reported that percentage CP in triticale ranged from 24.9 to 27.1% CP in winter and intermediate types. Coblentz and Walgenbach (2010) conducted a study to determine the nutritive value of small-grain forages utilized in the fall, and reported TDN values for triticale ranging from 64.5 to 69.6%. The concentration of TDN reported in their study was consistent throughout the fall-growing season, and triticale produced yields that were intermediate between oat and wheat (Coblentz and Walgenbach 2010). Brown and Almodares (1976) reported that triticale planted in October in northern Georgia produced 5,983 kg DM/ha from 4 harvests between December 7 and April 10. Many factors affect the yield and quality of triticale forage, the most influential of which the producer cannot control; e.g., temperature and precipitation.

The nutritive value of triticale is sufficient to produce highly satisfactory and profitable gain in beef cattle. Few studies have been conducted to evaluate animal performance from triticale grazed as a monoculture. Mullenix et al. (2014) conducted a study of small-grain forage monocultures and performance of stocker cattle in the Gulf Coast region. They reported that ADG from triticale was 1.23 kg/d over a 3-yr experiment, which is similar to values from other studies. Myers et al. (2007) conducted a study to evaluate triticale forage for growing beef cattle, and reported an ADG of 1.12 kg/d over a grazing season of 80 d.

*Wheat*

Wheat (*Triticum aestivum*) is a small grain that originated from the Fertile Crescent region of the world, dating back to 9,600 B.C. (Zohary and Hopf, 2012). Wheat is known for its cold and drought tolerance, and is usually grown where rice and corn cannot be cultivated (Gibson and Benson, 2002). Wheat is the most abundantly grown small grain in the world (Jennings, 2005). In the US, there were approximately 22,725,526 ha of all classes of wheat grown in 2012 (NASS, 2012). There are many classifications of wheat grown around the world. The 4 major classes of wheat grown in the US are hard-red spring, soft-red spring, durum and hard white (Paulsen and Shroyer, 2008). About 70 percent of the wheat planted in the US is winter wheat. Of the remaining wheat acreage, 24% is planted to spring wheat and 6% to durum (Gibson and Benson, 2002). The majority of wheat grown is utilized for baking and human consumption; however, it is also grown for animal feed. Due to its capacity for abundant forage yield and grazing tolerance, wheat is often managed as a dual-purpose crop. Approximately 30 to 80% of winter wheat is grown as dual-purpose crop in the

Great Plains (Zhan, 2010). Wheat's production paradigm does not make it a good candidate for use as a dual-purpose crop throughout all regions, so it is mainly grown for that purpose in the Southern Great Plains (Coblentz et al., 2010).

Wheat's yield potential and nutritive value vary considerably depending upon planting date, class of wheat and variety. Jennings (2005) reports that forage yields of wheat grown in Arkansas ranged from 2,924 to 10,788 kg/ha among all varieties tested. In a variety trial at Tifton, GA in 2012, average forage yield for wheat was 7,103 kg/ha (GAES, 2012). Colbentz et al. (2010) conducted a study to evaluate yield and nutritive value among fall-grown small grains. They harvested at 3 dates (September 15, October 6 and October 30) and found that the average CP concentration for wheat was 31.5, 22.5 and 18.5%, respectively. The calculated wheat TDN was 73% for the October 30 harvest date, which was the greatest value among the 3 harvests. Furthermore, the greatest forage yield was 3,269 kg/ha on the last harvest date. In a 3-yr study conducted in the Gulf Coast region, Mullenix et al. (2014) observed an average CP concentration for wheat of 16.2%, which was less than that of either ryegrass or triticale.

Wheat's high forage production capacity and high nutritive value make it an ideal winter-annual forage for putting weight on stocker cattle economically. While the amount of gain observed for stocker cattle differs according to stocking rate, grazing-days and many other factors, growth performance is similar to that from other winter-annual forages. Beck et al. (2005) conducted a 3-yr trial testing several small grains and combinations of small grains in Arkansas, and observed fall ADG of 1.15 kg/d and a spring ADG of 1.27 kg/d from wheat; average total gain/ha was 752 kg. Beck et al. (2007) conducted a trial in which they evaluated cool-season annuals planted into a bermudagrass sod for stocker cattle, and reported that wheat tended to support greater BW gain/ha than the other small grains tested. In a 3-yr study conducted in the Gulf Coast region of Alabama (Mullenix et al. 2014), wheat produced an ADG of 1.36 kg/d; furthermore, wheat produced the greatest number of steer-grazing-days/ha (497 d) compared with either ryegrass (406 d) or triticale (415 d).

*Rye*

Rye (*Secale cereale*) is another small-grain cereal crop that is native to the Middle East, where it is used primarily for making bread (Zohary and Hopf, 2012). Rye is the second most commonly grown small-grain forage in the Southeast (Jennings, 2005). In 2012, 526,091 ha of rye were planted in the US (NAAS, 2012). Known for its drought tolerance and winter hardiness, rye is the grain of choice by many producers in colder climates. Furthermore, due to its earlier maturation in the fall and spring, rye can be planted and grazed earlier than many other small grains.  According to Oelke et al. (1990), less than 50% of rye grown in the US is harvested as grain; the remainder is grown for pasture, hay or cover crop. Because of its high yield capacity, it is most suited for forage production compared with other small grains (Bruckner and Raymer, 1990). Rye seed is typically more expensive than wheat, but because it often yields more forage, it is frequently the more cost-effective choice (Jennings, 2005).

Rye's yield potential and nutritive value are dependent upon many environmental factors and also whether it is a forage or grain-type variety. Jennings (2005) reports that forage yields of rye grown in Arkansas ranged from 5,601 to 12,711 kg/ha among all varieties tested. In a variety trial performed by The University of Georgia at Tifton in 2012, the average forage yield for rye was 9,526 kg/ha (GAES, 2012).

Rye is similar to wheat for supporting ADG of stocker cattle. Beck et al. (2005) conducted a 3-yr trial testing several small grains and combinations of small grains in Arkansas, and reported that ADG (1.11 kg/d) from rye over the 3-yr period did not differ between fall and winter grazing seasons; average total gain/ha from rye was 645 kg. Beck et al. (2007) evaluated cool-season annual grasses planted into a bermudagrass sod for stocker cattle and found that rye produced the greatest spring ADG (1.17 kg/d) among all the species tested; rye supported 560 grazing-days/ha.

*Oat*

Oat (*Avena sativa*) is a small grain whose origins are unknown, but it is thought to date back to the 12$^{th}$ dynasty in Egypt, which was about 2,000 B.C. (Gibson and Benson, 2002). Oat was probably first discovered persisting as a weed-like plant in other cereals for centuries prior to being cultivated itself (Gibson and Benson, 2002). Oat is found throughout the entire US, and its planted acreage is rapidly growing. In Alabama there are, on average, 20,000 ha planted annually, with 6,000 ha of this being planted for grain purposes (NASS, 2012).

The remaining acreage is planted for forage (e.g., silage or grazing). Though varieties may differ, oat is generally more cold-sensitive than other small grains and can be susceptible to winterkill (Ball et al., 2007).

Oat is a high-yielding small-grain crop. Jennings (2005) reports forage yield for oat between 871 and 9,508 kg/ha in all varieties tested. In a variety trial performed by The University of Georgia at Tifton, GA in 2012, the average forage yield for oat was 8,437 kg/ha (GAES, 2012). In a 3-yr study conducted by Carr et al. (2004) evaluating oat as a grazing crop, oat produced an average of 3.84 Mg/ha.

Oat generally follows the same trend as other small-grain forages for supporting gain of stocker cattle. Because of its high nutritive value, it is a good crop for achieving economical gains in winter and spring months when perennials are lacking in yield and nutritive value. Beck et al. (2005) conducted a 3-yr trial testing several small grains and combination of small grains in Arkansas, and observed that ADG from oat was greater in the fall (1.13 kg/d) than the spring (1.02 kg/d); it is worth noting, however, that oat experienced winterkill in yr 2 of the study. Furthermore, they reported that average total gain/ha was 587 kg. Beck et al. (2007) conducted a study evaluating cool-season annual grasses planted into a bermudagrass sod for stocker cattle, and reported that oat produced a winter ADG of 0.42 kg/d and a spring ADG of 1.10 kg/d. Also, oat supported 535 grazing-d/ha, which was the least among all of the species tested.

## Annual Ryegrass

Two species of ryegrass are typically planted in the US: perennial ryegrass (*Lolium perenne*) and annual ryegrass (*Lolium multiflorum*). Annual ryegrass is the most common species planted in the southeastern US because it is better adapted to this region and yields greater forage production than perennial ryegrass. Annual ryegrass is a cool-season annual bunchgrass that is native to Southern Europe. Also known as Italian ryegrass, it is grown extensively across the US (USDA, 2012). Annual ryegrass is typically a diploid species, however; plantings of newer tetraploid varieties with twice as many chromosomes are becoming more common. Tetraploid varieties tend to have yields equal to or greater than diploid varieties, but they sometimes lack the winter hardiness of the diploid varieties. There are many varieties of annual ryegrass that can be planted to fulfill a variety of producer-specific needs.  Varieties such as 'Gulf', which was developed to have greater resistance to leaf rust, and ‘Marshall’, which was developed to be more cold tolerant, have helped expand the uses of annual ryegrass. Annual ryegrass can be planted in either a prepared seedbed or into a warm-season sod, however; when planted into a prepared seedbed, better establishment and greater forage yield are observed. Typically, ryegrass is planted for grazing, but it can be harvested as hay, baleage or silage (Ball et al., 2007). Ball et al. (2007) state that ryegrass’s seasonal growth is typically between November and May in the Gulf Coast region.  During the past 50 yr, the use of annual ryegrass has expanded significantly (Redfearn et al., 2002). Blount et al.

(2013) state that there are more than 1 million ha of annual ryegrass grown in the Southeast, from eastern Texas and Oklahoma to the Southeastern coast.

The yield and nutritive value of ryegrass exhibit a greater range than other cool-season annuals, and are more dependent on stage of maturity than the small-grain forages. Location and variety are major factors that likewise contribute to variability in yield and nutritive value. Hafley (1996) performed a study of two varieties of ryegrass, 'Surrey' and Marshall', from which he reported CP concentrations ranging from 11.1 to 27.0% throughout the grazing season. In variety trials performed at Tifton, GA, 2-yr average yield of ryegrass was 8,548 kg/ha among all varieties tested (GAES, 2012). Redfearn et al. (2002) evaluated several improved varieties of ryegrass for nutritive value and yield distribution throughout the growing season, and reported that approximately 40% of growth occurred from December to February, and 60% of growth accumulated from March to May. Mullenix et al. (2014) conducted a 3-yr study to evaluate 3 cool-season annuals grown as monocultures for stocker cattle production, from which they reported an average CP concentration of 17.0% for ryegrass. Furthermore, they observed that ryegrass had a lesser concentration of NDF (41.7%) and ADF (22.0%) than either wheat or triticale.

Ryegrass's high yield potential and high nutritive value make it an optimal choice for the winter-annual grazing season, and annual ryegrass is the primary winter-annual forage utilized through the Southeast. Hafley (1996) performed a study of 'Surrey' and 'Marshal' varieties of ryegrass planted in prepared seedbeds in which ADG for both varieties averaged 1.46 kg/d in the first year of the trial when treatments were continuously stocked. In a study conducted by Utley et al. (1976), greater ADG was observed for ryegrass that had been planted into a perennial sod (1.15 kg/d) than in a prepared seedbed (1.07 kg/d), but steer grazing-d/ha was greater from ryegrass planted in a prepared seedbed (465 vs. 220 d/ha). Mullenix et al. (2014) conducted a study to evaluate stocker cattle performance from 3 cool-season annuals grown as monocultures and observed that ryegrass supported an ADG of 1.54 kg/d, which was greater than triticale or wheat; also, they reported that ryegrass supported 406 grazing-days/ha.

**Small Grains and Ryegrass Grown in Mixtures**

In the southeastern US, opportunity exists for beef production from mixed pasture of ryegrass and small grains that differ in their respective growth patterns and thus enable availability of high-quality forage to be distributed more uniformly throughout the grazing season (Mullenix et al. 2012). It is common practice throughout the US to plant small-grain forages in combination with ryegrass in order to extend the winter-grazing season. Myer et al. (2011) noted that blending ryegrass with cereal forage resulted in longer grazing periods, increased forage yields, greater gain per ha and increased grazing days. Furthermore, mixtures of small grains may produce more uniform and greater distribution of yield that will result in increased animal performance (Myers et al. 2005). The concept behind planting mixtures of winter-annual species is stretching the supply of high-quality forage over a longer period when an early-maturing species is grown in combination with a later-maturing one (Jennings, 2005).

In a 5-year study conducted by Islam et al. (2011), rye combined with annual ryegrass produced an average of 1.05 kg/d ADG and 448 steer grazing-d/ha.

Beck et al. (2007) determined effects of mixtures of cool-season annuals combined with ryegrass that were planted into a bermudagrass sod on the performance of stocker cattle. Blending small-grain forages with ryegrass increased animal grazing-d/ha and BW gain/ha compared with monocultures. During the winter-grazing season (December 18 to March 12), there were no differences in ADG among species of small-grain forage when combined with ryegrass. However, during the spring-grazing season (March 12 to May 7), rye tended to support greater ADG than other small-grain forage and ryegrass mixtures. Also, the mixture of triticale with ryegrass produced less ADG than ryegrass alone or mixtures of ryegrass with rye or wheat.

Beck et al. (2005) evaluated performance of stocker cattle grazing mixtures of cool-season annuals. Mean ADG was 1.16 kg/d and was not affected by species of small- grain forage grazed during the fall and winter grazing months. Furthermore, they found that combinations of wheat with ryegrass (753 kg/ha) and rye and ryegrass (800 kg/ha) were not significantly different in production of total stocker gain per hectare. Furthermore, ADG in spring from a mixture of rye and ryegrass (1.32 kg d) was greater than from a mixture of wheat and ryegrass (1.24 kg/d).

Mullenix et al. (2012) evaluated beef performance from combinations of small-grain forage with ryegrass seeded into clean-tilled soil in the Gulf Coast region of Alabama. They found that oat and ryegrass mixtures yielded greater ADG (1.38 kg/d) and greater number of steer grazing-d/ha (461 d) than rye mixtures. The rye and ryegrass treatment had an average ADG of 1.13 kg/d and 385 steer grazing-d/ha. They concluded that adding rye into mixtures with ryegrass or with oat and ryegrass did not result in greater ADG or greater number of grazing-d/ha.

Myers et al. (2011) conducted a study on suitability of triticale blended with ryegrass as pasture forage for growing beef cattle in the Coastal Plain region. They found that blends of triticale and ryegrass produced an ADG of 1.20 kg/d, which was greater than ADG (1.09 kg/d) from a blend of rye and ryegrass.

## Implications of Future Research

Given historically high commodity feed prices, it is more important than ever to produce as much stocker liveweight gain as possible from grazing forages. The research presented in the following chapter is novel because it is directed at two relatively underutilized forages in the lower Gulf Coast region; i.e., wheat and triticale. These species are planted to a lesser extent than in other areas of the US where they are well adapted for winter grazing and often followed by production of a grain crop for cash sale (Coblentz and Walgenbach, 2010). Because of their desirable agronomic traits, expanded use of triticale and wheat in Gulf Coast beef cattle production systems is desired; however, information on productivity, nutritive value and capacity of these small-grain forages to support winter grazing by stocker cattle in the region is limited (Mullenix et al., 2014). The Gulf Coast Region remains warmer than most parts of the country where these species are more commonly grown, and it receives generous but highly variable amounts of precipitation from year to year. Production of summer-annual row crops such as peanut and cotton is very common in this region, and incorporation of winter grazing of small-grain forage and ryegrass mixtures on open farm land decreases overhead costs and can benefit the soil for row crops the following spring/summer. Furthermore, this research is novel because it involves mixtures of these small-grain forages with ryegrass. Previous research has shown how these species perform when planted in monoculture. However, when planted in mixtures, they likely perform differently because of their different growth patterns.

# II. Stocker Cattle Performance, Forage Quality and Productivity From Grazed Mixtures of Triticale and Wheat with Ryegrass

## Introduction

The greatest opportunity for profitability in the beef industry historically is stockering beef cattle on high-quality cool-season annual forages such as small grains and ryegrass (Hoveland, 1986). Grazing of cool-season annuals can be a profitable enterprise during the winter and spring when pastures and row-crop fields lay dormant and otherwise unused. In the southeastern US it is common practice to plant small grains and ryegrass in mixtures, which extends the grazing season and produces a more even distribution of forage over the course of the grazing season compared with monocultures (Mullenix et al. 2012). Considerable information exists about most small grains, but little information is available on mixtures of triticale and wheat in combination with ryegrass. The most common grazing method for cool-season annuals is continuous stocking at a fixed density. Fixed stocking densities do not complement changes in forage growth rate and availability throughout the growing season, which can lead to under grazing and less efficient forage utilization at times of peak forage abundance (Mullenix et al. 2012). The objective of this study was to determine productivity, forage quality characteristics, and stocker cattle performance from aggressively managed triticale and wheat in mixtures with ryegrass using adjustable stocking densities in response to changing forage availability.

## Materials and Methods

*Research site*

A 2-yr winter-grazing experiment was conducted at the Wiregrass Research and Extension Center in Headland, AL (31.35° N lat, 85.34° W long). Six 1.42-ha paddocks composed of Dothan fine sandy loam were used for this experiment. In Yr 1, pastures previously had been planted in pearl millet (*Pennisetum glaucum*) and annual peanut (*Arachis hypogaea*) in the preceding spring and summer. In Yr 2, all pastures had been planted in pearl millet during the preceding summer and were utilized for summer grazing.

*Pasture establishment and fertilization*

Triticale (× *Triticosecale*) and wheat (*Triticum aestivum*) were planted in binary or ternary mixtures with ryegrass (*Lolium multiflorum*) as winter pasture for grazing beef cattle. In Yr 1, paddocks were disked and sub-soiled on October 16, 2012 with a KMC subsoiler and leveler (Kelley Manufacturing Co., Tifton, GA). Paddocks were assigned randomly to forage treatments (2 paddocks/treatment), and forages were seeded with a no-till Great Plains drill on November 30, 2012 (Great Plains Mfg., Salina, KS). In Yr 2, paddocks were disked and sub-soiled on September 9, 2013**,** assigned randomly to treatments (2 paddocks/treatment) with the restriction that no paddock could be assigned to the same treatment as in Yr 1, and no-till drill-seeded on November 4, 2013. Seeding rates in both yr were 105 kg/ha of either 'Trical 2700' triticale (Resource Seeds Inc., Gilroy, CA) or 'SS 8641' wheat (Southern States, Richmond, VA) and 11 kg/ha for 'Marshall' ryegrass (Wax Seed Company, Amory, MS) for binary mixtures. Ternary mixtures were seeded at 43 kg/ha for each of the small grains and 11 kg/ha of ryegrass. The experimental layout is presented in Figure 1 for Yr 1 and 2, respectively.

In Yr 1, paddocks were fertilized with 34 kg N/ha, 45 kg P/ha and 45 kg K/ha in the form of $NH_4NO_3$, $P_2O_5$ and $K_2O$, respectively, on October 22, 2012 according to soil-test recommendations provided by Auburn University Soil Testing Laboratory. On December 14, 2012, N and S were applied in the form of $NH_4NO_3$ and $(NH_4)_2SO_4$, respectively, at rates of 78 kg N/ha and 11 kg S/ha, respectively. On March 20, 2013, each paddock received 67 kg N/ha. In Yr 2, plots were fertilized with 34 kg N/ha, 45 kg P/ha and 6 kg K/ha on October 1, 2013 according to soil-test recommendations. On November 18, 2013, N and S were applied at rates of 78 kg N/ha and 11 kg S/ha, respectively. On February 7, 2014, each paddock received 67 kg N/ha and 10 kg S/ha.

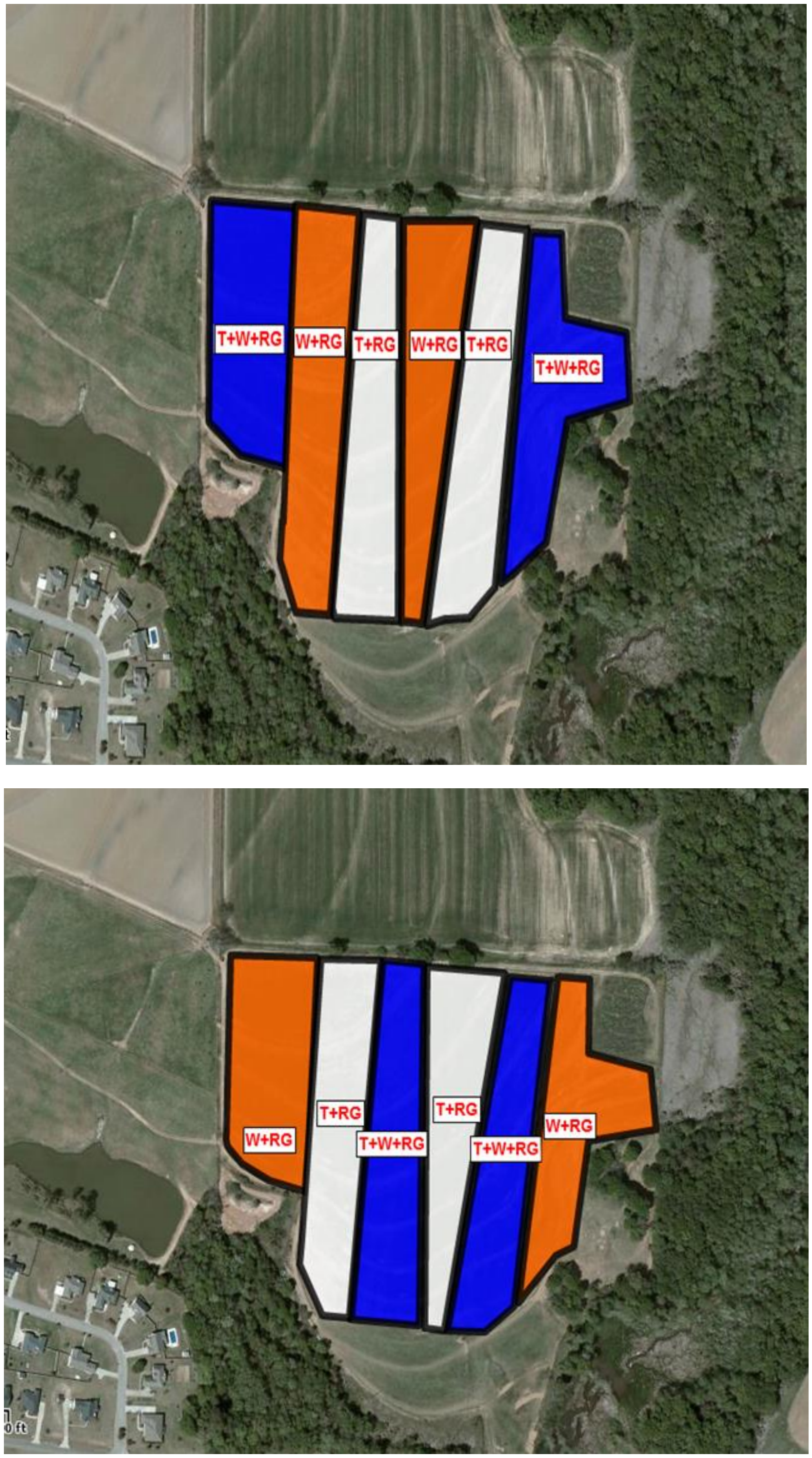



Figure 2. Layout of experiment plots Yr 1 (top) and Yr 2 (bottom). W + RG = wheat and ryegrass; T + RG = triticale and ryegrass; W + T + RG = wheat, triticale and ryegrass

*Animal and pasture management*

Each pasture was stocked initially with 4 Angus × Simmental 'tester' steers with an initial BW of 388 ± 98 and 346 ± 52 kg in Yr 1 and Yr 2, respectively. Steers were born in the fall prior to the experiment. After weaning, steers were placed on bermudagrass (*Cynodon dactylon*) pastures until the winter-grazing study was conducted. When bermudagass became limiting in quantity, steers were provided *ad libitum* access to bermudagrass hay and 1.81 $kg \cdot head^{-1} \cdot d^{-1}$ of a 40:60 whole cottonseed-corn mixture in Yr 1. In Yr 2, steers were provided *ad libitum* access to bermudagrass hay and 2.7 $kg \cdot head^{-1} \cdot d^{-1}$ of pelleted soyhulls. Prior to the study, animals were tagged for identification and then dewormed with Cydectin pour-on dewormer (Boehringer Ingelheim, Ridgefield, CT). Throughout the trial animals had free-choice access to a commercial mineral mix (Mag Plus Beef Mineral/salt , Southern States Cooperative, Inc., Richmond, VA) and clean water. Unshrunk weights of 'tester' steers were taken at successive 28-d intervals and utilized to make stocking density adjustments. The management of cattle was conducted in accordance with a protocol approved by the Institutional Animal Care and Use Committee of Auburn University.

In Yr 1, grazing was initiated on January 29, 2013 when forage mass had achieved a mean value across all paddocks of 1,128 kg DM/ha, and 4 'tester' steers (initial BW, 388 ± 98 kg) were placed on each paddock.

In Yr 2, grazing was initiated on December 16, 2013 when forage mass had achieved a mean value across all paddocks of 440 kg DM/ha, and 4 Simmental × Angus tester steers (initial BW, 346 ± 52 kg) were placed on each paddock. In both yr, forage was managed to maintain similar grazing pressure and forage allowance among treatments using the put-and-take method as described by Sollenberger and Burns (2001). Stocking density adjustments were made on the basis of calculations of forage mass and steer BW on a bi-weekly basis. Grazing was terminated on May 22, 2013 and May 26, 2014 in Yr 1 and Yr 2, respectively, when forage mass and nutritive quality could no longer sustain an ADG of 0.91 kg.

*Forage sampling and laboratory analysis*

Prior to the experiment and every 2 wk thereafter, forage was sampled from 8 randomly selected locations within each paddock in order to determine herbage mass and nutritive value. Samples were clipped from within a 0.25-$m^2$ quadrat to a stubble height of approximately 5 cm, placed in zip-loc bags and placed on ice, and then transported to the Auburn University Ruminant Nutrition Laboratory. Samples were transferred to paper bags and dried for 72 hr at 60ºC. Samples were then air-equilibrated and weighed. Forage mass was calculated for each paddock, and forage allowance was calculated as kg DM divided by kg total animal liveweight per paddock.

Dried forage samples were ground in a Wiley mill (Thomas Scientific, Swedesboro, NJ) to pass a 1-mm screen. Concentrations of CP and DM were determined according to AOAC procedures (1995). Concentrations of NDF, ADF and ADL were determined according to Van Soest et al. (1991). Samples were analyzed for IVDMD based on the Van Soest (1991) modification of the Tilley and Terry procedure (1963) using the Daisy II® incubator system (Ankom Technology, Macedon, NY). Ruminal fluid for batch-culture incubations was collected mid-morning through a permanent indwelling cannula from a rumen-fistulated Holstein cow that had free access to bermudagrass pasture and was limit-fed a supplement containing cracked corn, distillers dried grains, corn gluten feed, soyhull pellets, soybean meal, cottonseed meal, and cottonseed hulls. Fluid was placed into a preheated insulated container and transported immediately to the Auburn University Ruminant Nutrition Laboratory for processing.

*Statistical analysis*

Tester steer data were used to calculate initial BW, final BW and ADG. Data for all steers (i.e., tester and put-and-take steers) were used to calculate stocking rate, forage allowance and grazing-d/ha. Total gain/ha was calculated for each pasture using pasture ADG of tester calves and total grazing-d/ha of both tester and put-and-take steers (Beck et al., 2011). Data were analyzed as a completely randomized design using the PROC MIXED procedure of SAS 9.3 (SAS Inst. Inc., Cary, NC). Main effects were treatment, year, and treatment × year interaction. Forage metrics and nutritive value data were treated as repeated measures. The PDIFF option of LSMEANS was used to separate treatment means when protected by *F*-test at $\alpha = 0.10$.

## Results and Discussion

### *Temperature and precipitation*

Monthly mean and 30-yr average monthly mean temperature at the research site from September to May of each yr are presented in Figure 2, and monthly total and 30-yr average monthly total precipitation between September and May of each yr are presented in Figure 3. Mean monthly temperature in year 1 was greater in December, January and February, but was lower in March, than the 30-yr average. In yr 2, the mean temperature in November, January and March was considerably less than the 30-yr average. In yr 1, total precipitation in October, November and January was 34, 72 and 73% less, respectively, than the 30-yr average. In year 2, total precipitation in December and April was 91 and 274% greater, respectively, than the 30-yr average, whereas total precipitation in October, November and March was 95, 38 and 50% less, respectively, than the 30- yr average. In yr 1, land use conflict with peanut harvest coupled with reduced precipitation delayed planting of experimental forages, which also delayed turn out of cattle onto paddocks for grazing. In yr 2, timely rainfall allowed for an earlier planting date compared with yr 1 that, combined with warmer than average December temperatures, enabled turnout in late December.

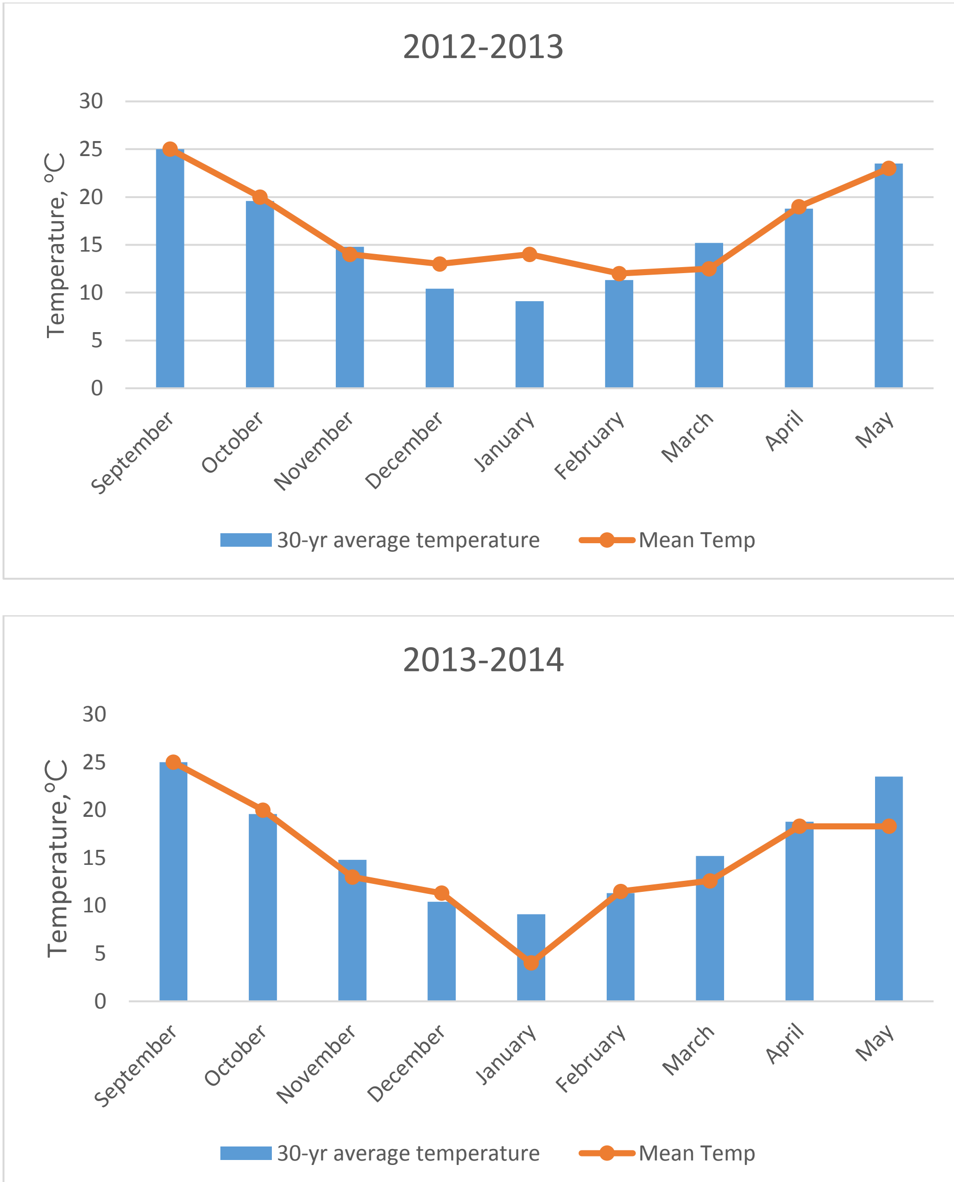
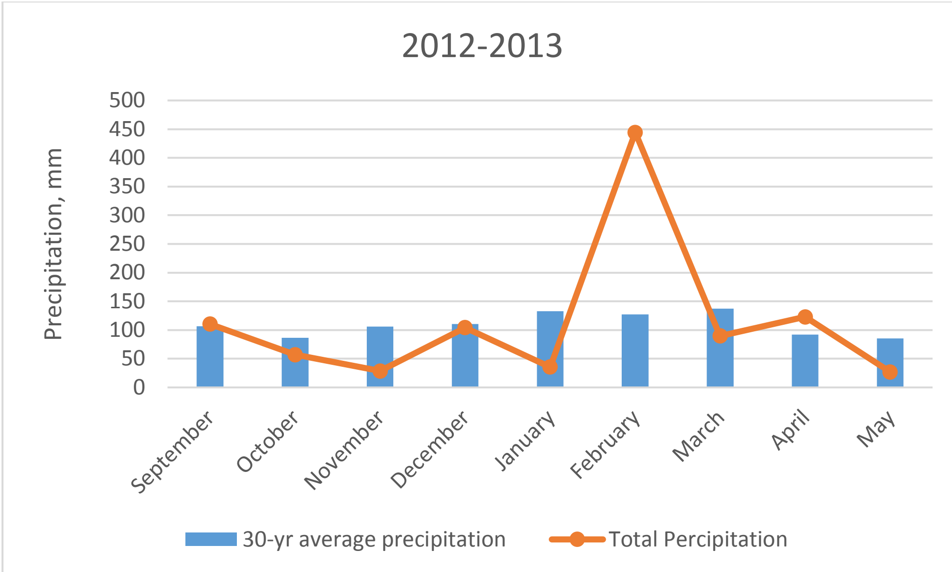



Figure 2. Monthly and 30-yr average temperature from September to May by yr at Wiregrass Research and Extension Center, Headland, AL.



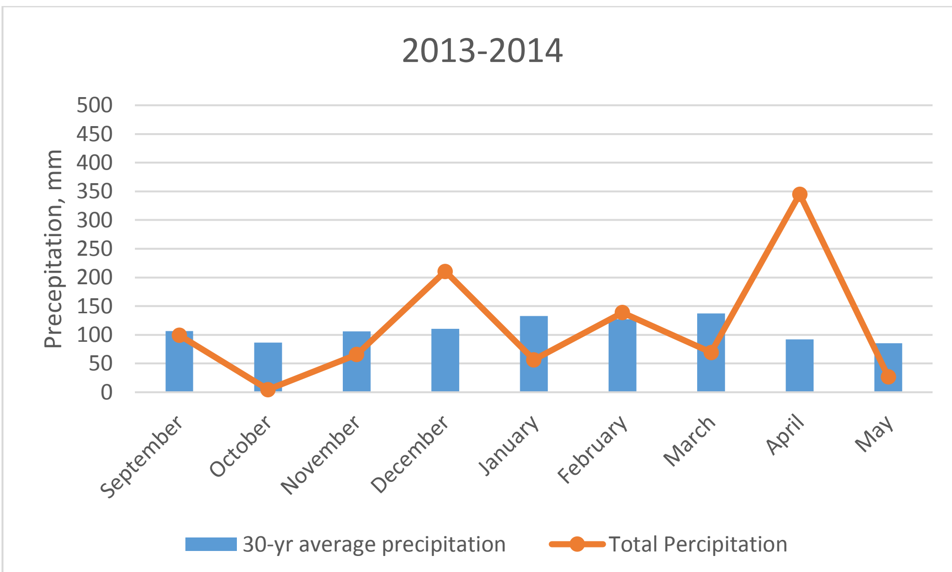




Figure 3. Monthly and 30-yr average precipitation from September to May by yr at Wiregrass Research and Extension Center, Headland, AL.

*Forage mass and allowance, grazing days and stocking rates*

Forage mass across both yr (Table 1) did not differ (*P* = 0.99) among treatments, which was projected because of the put-and-take forage management strategy. Exceptionally cold temperatures and limited precipitation in January of Yr 2 contributed to decreased (*P* < 0.001) mean forage mass compared with Yr 1 (830vs. 1,355 kg DM/ha, respectively). Coffey et al. (2002) reported forage mass for continuously stocked (2.5 steer/ha) wheat + ryegrass and ryegrass alone that ranged from 403 to 4,276 kg DM/ha over a 3-yr study. Soares and Restle (2002) reported slightly greater forage mass for triticale blended with ryegrass that ranged from 1,404 to 1,619 kg/ha across different levels of N fertilizer applications. Myer et al. (2011) reported a forage mass of 4,824 kg/ha for ungrazed triticale over an 80-d growing season; blending of ryegrass with triticale increased forage mass (6,623 kg DM/ha) and supported a 112-d grazing season. Fieser et al. (2006) reported a mean forage mass of 2,449 and 1,128 kg DM/ha for early and late planted dual-purpose wheat, respectively. Differences in forage mass between the present study and other studies are attributable primarily to different forage management practices and different weather conditions. The variable range in forage mass reported by Coffey et al. (2002) was due to extremely dry conditions in fall and early winter and minimal moisture throughout yr 3 of their study. Furthermore, animals in their study were supplemented with 0.9 $kg \cdot head^{-1} \cdot d^{-1}$ of a sorghum-based supplement that may have resulted in decreased forage consumption. Value for forage mass in the study by Sores and Restle (2002) were greater than in the present study because they maintained a greater forage allowance (1.5 kg DM/kg live-weight). Mean forage mass for early-and-late planted dual-purpose wheat in the study by Fieser et al. (2006) were greater than in the present study primarily due to lower stocking densities (0.91 to 2.05 steer/ha).

Forage allowance across both yr (Table 1) did not differ ($P = 0.65$) among treatments. Whereas a target forage allowance of 1 kg forage DM/kg steer BW was established at the beginning of the study, the actual mean forage allowance (0.89 kg DM/kg BW) across both yr was 10% less than the target allowance. Due to suboptimal early-season growing conditions and low forage mass in Yr 2 compared with Yr 1, forage allowance could not be maintained at the desired target value, but similar forage allowance was still maintained across treatments. In a nonlinear analysis of data from several grazing studies performed by Beck et al. (2013), ADG was maximized at a forage allowance of 3.5 kg DM/ kg BW, which yielded a predicted ADG of 1.25 kg/d. This particular analysis utilized data from grazing studies conducted in the Upper South that included cool-season annuals, cool-season perennials and warm-season grasses that had been planted by various methods (e.g., prepared seedbed, interseeded into warm-season sod, etc.) and were possibly supplemented with different feedstuffs at different rates. The present study achieved different ADG than predicted by the Beck et al. (2013) analysis, presumably because of differences in establishment methods, forage species and research locations. Redmond et al. (1995) reported an increase in ADG from wheat as forage allowance increased above a range of 0.20 to 0.24 kg DM/kg BW. They also reported that, as forage allowance declined below a range of 0.20 to 0.24 kg DM/kg of BW, ADG declined markedly. Fieser et al. (2006) conducted a study on forage allowance in relation to growth performance by growing steers in a dual-purpose winter wheat system. They reported that BW gain/ha peaked at the least forage allowance (2.0 kg DM/kg BW) and decreased as forage allowance increased.  They also reported that ADG was greatest at a forage allowance of 7 kg DM/kg BW for both early- and late-planted wheat. Their data illustrated that, as forage allowance increased, ADG also increased; however total BW gain/ha decreased.

Grazing-d/ha across both yr did not differ (*P* = 0.99) among treatments. The mean value of 375 grazing-d/ha is less than that reported by Beck et al. (2007) for combinations of small grains and ryegrass (613) planted into a bermudagrass sod. This difference is likely attributable to an additional application of N in the spring of each yr, provision of supplement and utilization of greater stocking densities compared with the present study. Morgan et al. (2012) observed a greater number of grazing-d/ha (564) for conventionally tilled wheat. Myer et al. (2008) observed 366 grazing d/ha for ryegrass, and Mullenix et al. (2014) reported a 3-yr mean of 439 grazing-d/ha for monocultures of triticale, wheat and ryegrass. Mullenix et al. (2014) value is slightly greater because they utilized greater stocking densities (3.5 steer/ha) and lighter steers than in the present study. In a study conducted to determine the suitability of triticale as a monoculture or mixture with ryegrass, Myer et al. (2011) reported a mean of 333 and 459 grazing-d/ha for triticale and triticale + ryegrass, respectively. Differences among these various studies in grazing-d/ha achieved from small grains and ryegrass are likely attributable to differences in management strategies (i.e., forage allowance, stocking densities and/or forage accumulation at time of turnout) and (or) climatic conditions.

Stocking density across both yr was not different (*P* = 0.98) among treatments. The mean stocking density of 2.94 steer/ha is less than that (3.5 steers/ha) reported for monocultures of wheat, triticale and ryegrass over a 3-yr period at the same location (Mullenix et al., 2014). Meyers et al. (2008) reported a stocking density for ryegrass of 3.8 steer/ha, and in a subsequent 2-yr study (Myer et al., 2011) reported stocking densities of 0.7 steer/ha for both triticale and triticale blended with ryegrass. Fieser et al. (2006) reported stocking rates of 0.84 to 2.10 and 0.62 to 2.05 steer/ha for early- and late-planted wheat, respectively, that yielded mean ADG of 1.16 and 0.95 kg, respectively. Morgan et al. (2012) reported that, as stocking rate increased, ADG from wheat pasture decreased; however, grazing-d/ha and total BW gain/ha increased as stocking rate increased. As with grazing-d/ha, differences among these studies in stocking rates for small grains and ryegrass are attributable presumably to different prevailing weather conditions and forage-management strategies.

Table 1. Repeated-measures mean forage mass and allowance, grazing-d/ha and stocking density of grazed mixtures of winter-annual forages.

| Item | Treatment[1] W+T+RG | W+RG | T+RG | Mean | SE |
|---|---|---|---|---|---|
| Forage mass, kg DM/ha | 1,089 | 1,093 | 1,097 | 1,093 | 88 |
| Forage allowance, kg DM/kg steer BW | 0.88 | 0.92 | 0.87 | 0.89 | 0.04 |
| Grazing-d/ha[2] | 374 | 376 | 374 | 375 | 15 |
| Stocking density, steer/ha | 2.93 | 2.96 | 2.93 | 2.94 | 0.12 |

[1] W+T+RG = wheat + triticale + ryegrass; W+RG = wheat + ryegrass; T+RG = triticale + ryegrass.

[2] Calculated as stocking density (steer/ha) × length of grazing season (d).

*Forage chemical composition and nutritive value*

Forage concentration of CP (Table 2) across both yr did not differ (*P* = 0.94) among treatments. Mean concentration of CP (19.5%) across treatments exceeded the requirement for growing-finishing beef steers to gain ≥ 1.20 kg/d (NRC, 1996). Blount et al. (2009) reported an average CP concentration of 25.5% for triticale and 25.9% for ryegrass planted as monocultures in north Florida. In south Florida, Vendramini et al. (2013) evaluated triticale mixed with ryegrass and reported a mean CP concentration of 16%. Myer et al. (2011) reported concentrations of CP for mixtures of triticale and ryegrass that were very similar (average of 19.7%) to those in the present study. Hafley (1996) reported a wider range of CP concentrations (10.7 to 26.1%) for continuously stocked 'Marshall' ryegrass in a 2-yr study. Rosser et al. (2013) reported CP concentrations of wheat ranging from 9.8 to 18.6% at various growth stages ranging from stem elongation and heading to fully mature.

There were no differences (*P* = 0.24) in concentration of NDF among treatments, for which the mean value across both yr was 43.6%. Mullenix et al. (2014) observed similar NDF concentrations (45.7%) in monocultures of the same species as those in the present experiment. Coblentz and Walgenbach (2009) reported NDF concentrations ranging from 37.3 to 48.2% for wheat and triticale over 3 harvests in the fall, in agreement with the current study. Blount et al. (2009) reported NDF concentrations of 41.5 and 40.6% for ryegrass and triticale, respectively, at boot stage. Beck et al. (2007) reported season-long NDF concentrations ranging from 40 to 52% for mixtures of small grains and ryegrass in Arkansas. Hafley (1996) reported NDF concentrations for 'Marshall' ryegrass ranging from 40.5 to 57.1% over three 28-d harvests. Rosser et al. (2013) reported NDF concentrations in wheat harvested at different maturities ranging from 50.5 to 59.9%. In a study of grazed wheat pasture, Morgan et al., (2012) reported NDF concentrations of 39 to 52%.

There were no differences (*P* = 0.82) in concentrations of ADF among treatments, for which the mean value across both yr was 24.1%. In a 1-yr case study of grazed mixtures of small grains and ryegrass, Mullenix et al. (2012) reported ADF concentrations ranging from 28.5 to 39.6% in binary and ternary mixtures of  oats and rye with ryegrass. In an experiment conducted by Coblentz and Walgenbach (2009) with wheat and triticale, ADF concentrations ranged from 20.1 to 27.3% over 3 harvests in the fall, in agreement with values observed in the current study. Mullenix et al. (2014) reported mean ADF concentration (24.5%) for monocultures of triticale, wheat and ryegrass that were similar to those in the present study. Phillips et al. (1999) reported winter dual-purpose wheat ADF concentrations of 21.3 and 20.9% for yr 1 and 2, respectively, from a study in Oklahoma.

There were no differences (*P* = 0.67) across both yr in forage concentrations of ADL among treatments, for which the mean value was 1.2%. Coblentz and Walgenbach (2009) reported lesser values ranging from 0.52 to 0.70% for 3 harvests of wheat and triticale, which may be attributed to the use of different varieties and a much shorter growing season than in the present study. Mullenix et al. (2014) reported slightly greater lignin concentrations (1.7%) than those in the present study.

Percentage IVDMD (Table 2) was not different (*P* = 0.98) among treatments, for which the mean value across both yr was 90.9%. In a study conducted by Myers et al. (2011) with triticale-ryegrass mixtures, mean percentage IVOMD was 76.0%. Redmond et al. (1995) reported mean IVOMD values for wheat of 70.8% over a 2-yr study. Rao et al. (2000) report whole-plant triticale IVDMD ranging from 31.5 to 47.7%, which was less than whole-plant wheat (31.5 to 54.3%) across a 4-yr study. Coffey et al. (2002) reported IVDMD percentages that ranged from 53.6 to 82.1% for wheat + ryegrass, ryegrass and rye + ryegrass over a 3-yr study.  Myer et al. (2008) reported IVOMD for ryegrass of 79.9% for ryegrass planted as a monoculture, and in another study (Myer et al., 2011) reported mean percentage IVOMD for triticale and triticale + ryegrass of 72.5 and 76.0%, respectively.

The values in most of these aforementioned studies tend to be less than those in the present study, which may be attributed to use of different procedures for determining in vitro digestibility, as well as to agronomic factors such as stage of maturity at harvest. Several studies such as Redmond et al. (1995), Coffey et al. (2002), Myer et al. (2008), Myer et al. (2011) and Rao et al. (200) utilized batch-culture procedures that included acid-pepsin treatment  instead of neutral-detergent extraction of fermentation residues. The former leaves behind microbial debris that yields an estimate of apparent digestibility rather than true digestibility following extraction of residues with neutral detergent solution (Van Soest, 1991). The lesser values reported by Rao et al. (2000) may be attributed to below-average precipitation and warmer temperature in the spring, which likely hastened forage maturation.

Table 2. Mean chemical composition of grazed mixtures of winter-annual forages (DM basis).

| | Treatment[1] | | | | |
|---|---|---|---|---|---|
| Item | W+T+RG | W+RG | T+RG | Mean | SE |
| CP, % | 19.7 | 19.3 | 19.6 | 19.5 | 0.85 |
| NDF, % | 43.9 | 42.2 | 44.8 | 43.6 | 1.11 |
| ADF, % | 24.2 | 23.7 | 24.5 | 24.1 | 0.92 |
| ADL, % | 1.2 | 1.2 | 1.3 | 1.2 | 0.05 |
| IVDMD, % | 90.8 | 91.1 | 90.9 | 90.9 | 0.84 |

[1] W+T+RG = wheat and triticale and ryegrass; W+RG = wheat and ryegrass; T+RG = triticale and ryegrass.

*Steer ADG and total gain/ha*

Steer ADG across both yr (Table 3) did not differ (*P* = 0.54) among treatments. The mean ADG across all treatments of 1.44 kg in the present experiment is greater than that reported by Beck et al. (2007) for wheat + ryegrass and triticale + ryegrass that was interseeded into a bermudagrass sod. The lesser ADG in their study is also a result of greater stocking rate and forage allowance. Steer ADG in the present experiment were greater than those reported by Beck et al. (2005) from wheat + ryegrass (1.24 kg) in both fall and spring. Mullenix et al. (2014) observed mean ADG (1.37 kg) from monocultures of triticale, wheat and ryegrass that were comparable to that in the present study. DiLorenzo (2012) reported ADG of 0.71 kg/d for triticale + ryegrass over an 84-d grazing season in north Florida, which may in part reflect greater forage mass than in the present study. Myer et al. (2008) reported ADG of 1.12 kg/d from ryegrass planted in monoculture, and subsequently (Myer et al., 2011) reported ADG from triticale and triticale + ryegrass of 1.12 and 1.2 kg, respectively. Their lesser ADG than in the present study may have resulted in part from utilization of a greater stocking density.

Total steer BW gain/ha was not different (*P* = 0.74) among treatments. The mean gain/ha of 541 kg is comparable to that (524 kg) reported by Beck et al. (2007) from cool-season forage mixtures interseeded into bermudagrass sod. Morgan et al. (2012) reported a total BW gain/ha of 528 kg for conventionally tilled wheat. Beck et al. (2005) reported a total BW gain/ha of 753 kg from wheat blended with ryegrass that was greater than in the present study, presumably reflecting their use of a greater stocking density over the course of the experiment. Myer et al. (2008) reported total gain/ha of 366 kg from ryegrass alone, which is less than in the previous experiment because ryegrass alone had a shorter grazing season length (90 d). Beck et al. (2007) reported total gain/ha of 348 and 619 kg for triticale + ryegrass in the first and second yr, respectively, of a 2-yr study, but a greater gain/ha (466 and 661 kg, yr 1 and 2, respectively) from wheat + ryegrass. The difference in values compared with the present study may be attributed to a supplement that was fed at 0.91 kg/head/d, which allowed for a greater stocking density. Myer et al. (2011) reported 365 kg/ha for triticale compared with 558 kg/ha for mixture of triticale and ryegrass, which was comparable to the present experiment.

Table 3. Steer initial BW, final BW, ADG and gain/ha of grazed mixtures of winter-annual forages

| Item | Treatment[1] | | | Mean | SE |
|---|---|---|---|---|---|
| | W+T+RG | W+RG | T+RG | | |
| Initial BW, kg | 375 | 349 | 347 | 357 | 35 |
| Final BW, kg | 535 | 537 | 536 | 536 | 15 |
| ADG, kg | 1.39 | 1.49 | 1.45 | 1.44 | 0.13 |
| BW gain/ha, kg[2] | 522 | 558 | 542 | 541 | 31 |

[1] W+T+RG = wheat and triticale and ryegrass; W+RG = wheat and ryegrass; T+RG = triticale and ryegrass.
[2]BW gain/ha = ADG × grazing-d/ha - Beck et al. (2011)

*Conclusions*

Results from this study are interpreted to mean that mixtures of wheat and triticale with ryegrass were comparable, and the ternary mixture offered no advantage over binary mixtures, in their capacity to support highly satisfactory ADG and total beef production per unit of land area from winter-grazing of these forage species. Because mixtures of triticale and wheat with ryegrass were aggressively managed, potential differences among species were minimized in relation to gains predicted from a wide range of forage allowances reported in the literature (Beck et al., 2013). This information is especially useful to beef producers in Alabama and throughout the Lower Coastal Plain and Gulf Coast regions who may be interested in modifying their winter-grazing management practices to include variable-rate stocking densities for better synchronization with changing forage availability. Further research is needed to determine the performance of stocker cattle on newer, improved varieties of small-grains and tetraploid ryegrass.

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