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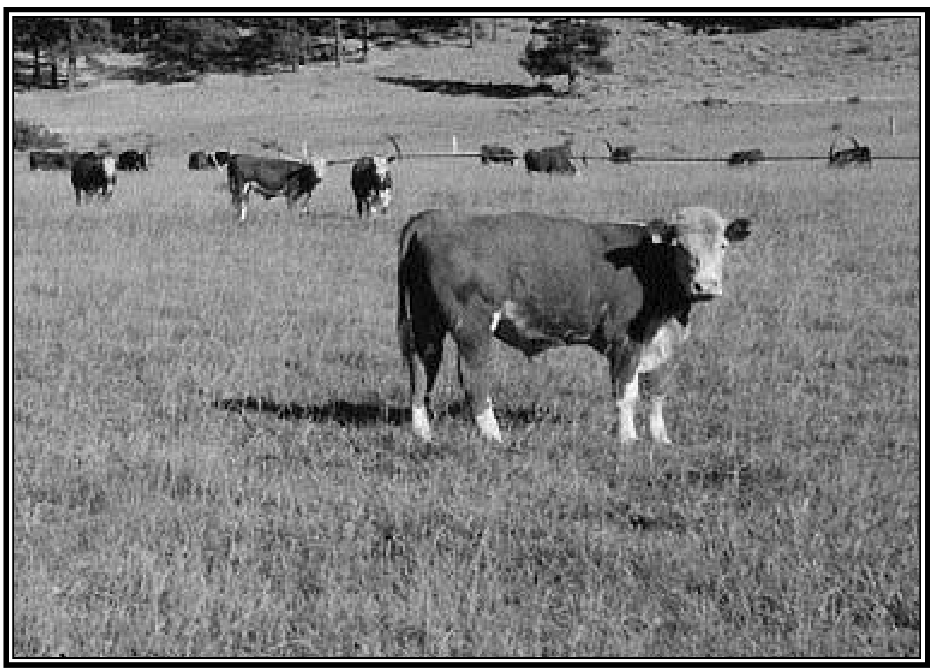

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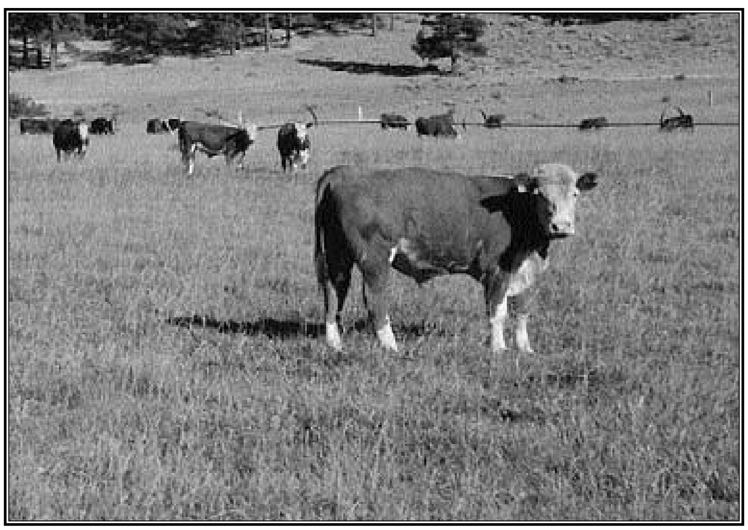

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Impact Statement

A three year study at the Livestock and Forestry Research Station near Batesville, Arkansas evaluated production systems involving stocker cattle and soft red winter wheat. Grazing of soft red winter wheat forage from October through February followed by harvesting wheat grain or grazing through April with stocker cattle offers an alternative to conventional farming. Soft red winter wheat, when planted by September 15, produces an ample supply of high-quality forage that supports rapid growth of stocker cattle during October through April. Net income from stocker cattle averaged over $100 per acre. A normal wheat grain crop can also be harvested. These alternative production systems could increase the agricultural income by over $75,000,000 per year if 750,000 acres of wheat are grazed.

Introduction

The number of farms in the United States is declining because of a lack of net income from the farming operation. Survival of the family farm depends on obtaining maximum net income from the land while maintaining its sustainability and protecting the environment. To accomplish this, multiple crops that result in net income must be produced on the land each year to increase net return per acre. Production systems that integrate stocker cattle production with the production of soft red winter wheat may have merit in the southern United States and especially in Arkansas. Several million acres of soft red winter wheat are planted for grain production in the southern United States annually. Arkansas leads the nation in the production of soft red winter wheat, producing over 45,000,000 bushels of grain annually (Klugh, 1999) from about one million acres.

Wheat farmers must have a secondary source of net income from their land. One system that has been tried is to double-crop wheat with soybeans. This system is limited because of a lack of soil moisture following the harvesting of wheat in mid to late June and because of possible frost damage to soybeans in the fall before the beans mature.

The production of stocker cattle from grazing hard red winter wheat forage in the Southern Plains is a unique and economical renewable resource. Income is derived from both grain and the increased value that is added as weight gain to growing cattle that grazed winter wheat forage. This has been a practice for many years in the Southern Plains (Horn et al., 1994). Grazing soft red winter wheat forage in Arkansas may offer an alternative source of net income to wheat and/or cattle producers.

Because of the even distribution and amount of rainfall and the warmer winter temperature, soil and climate conditions favor the production of soft red winter wheat forage in the southern United States over hard red winter wheat produced in the Southern Plains. Most of the land planted to soft red winter wheat in Arkansas will support grazing of stocker cattle even though it may receive 14 to 15 inches of rainfall from October through April. Over 25 percent of the nation's beef cows are located in the southern United States (Taylor, 1994). Approximately one million beef cows, which produce nearly 875,000 calves annually, are located in Arkansas (Klugh, 1999). Many of these calves are sold at weaning during the fall to cattlemen in the Southern Plains and western states as stocker cattle and graze wheat forage before they are placed in feedlots. Arkansas has an ample supply of stocker cattle available from within and from surrounding states to develop a sizable stocker cattle industry.

Therefore, it was the objective of a three-year study to

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evaluate production systems involving stocker cattle and soft red winter wheat. The systems were:

1. Grazing soft red winter wheat with stocker cattle from November until approximately March 1, followed by harvesting wheat grain in June.
2. Grazing soft red winter wheat forage with stocker cattle from November through April.

Materials and Methods

Three years of research evaluating production systems involving stocker cattle and soft red winter wheat were conducted beginning in 1996 and ending in 1999 at the University of Arkansas Livestock and Forestry Research Station near Batesville, Arkansas.

One hundred twenty acres at the Livestock and Forestry Research Station which had previously been used as pasture for dairy cows (primarily bermudagrass, summer annuals and alfalfa) were developed into uniform pastures for stocker cattle during the summer of 1996. A five-strand barbwire fence was built around the perimeter of the 120 acres and a high-voltage electric fence was used to subdivide the 120 acres into 60 2-acre pastures. Ball type fountain waterers were installed in each of the 2-acre pastures.

Twenty-four 2-acre pastures, having a Peridge silt loam soil, were treated with Roundup™ three times with 1/3 gallon per treatment per acre during the summer of 1996 to kill the existing vegetation. After killing the vegetation, all pastures were tilled to prepare a seedbed. Individual soil test analyses were conducted on each pasture annually. Pastures were fertilized each year according to soil test analysis for wheat grain production by broadcasting with ground equipment before seeding of wheat.

Pastures were seeded on September 10-11 during 1996 and 1997 and on September 18 in 1998 with either Hickory or Jaypee cultivars of soft red winter wheat at a seeding rate of 120 pounds per acre. Half of the pastures seeded to each cultivar were top-dressed with urea at seedling emergence to supply 50 pounds of additional nitrogen per acre. Forage samples were taken by cutting forage in 10 locations with scissors every 28 days from each pasture, beginning at the time grazing was initiated, to monitor forage quality. The wheat forage samples were dried in a forced air oven and were analyzed for crude protein (CP), in vitro dry matter digestibility (IVDMD), neutral detergent fiber (NDF), and acid detergent fiber (ADF) in the University of Arkansas Department of Animal Science nutrition analysis laboratory.

Each year, 60 pre-conditioned commercial mixed breed steers, having an average body weight of 500 + 11 pounds, were assigned to each of eight treatment groups when wheat forage was at stage 2, level 28 as described by Stauss, 1994 (Table 1). (Preconditioning included: Calves were vaccinated with a 7-way blackleg [alpha7], tetanus, modified live IBR-BVD-PI3-BRSV plus H. somnus [Express 4-HS] and pasturella [Pulmogard], and dewormed with injectable Ivomec. Bulls were castrated and horns were tipped if necessary. Booster vaccines were given 17 to 21 days after initial vaccinations; and steers were implanted with Ralgros.™)

The eight treatment groups were:

1. Hickory wheat with no additional nitrogen (N), having a stocking density of 500 lb of beef (one steer) per acre.
2. Hickory wheat with no additional N, having a stocking density of 750 lb of beef per acre (one and one-half steers per acre).
3. Hickory wheat with an additional 50 lb of N per acre, having a stocking density of 500 lb of beef per acre.
4. Hickory wheat with an additional 50 lb of N per acre, having a stocking density of 750 lb of beef per acre.
5. Jaypee wheat with no additional N, having a stocking density of 500 lb of beef per acre.
6. Jaypee wheat with no additional N, having a stocking density of 750 lb of beef per acre.
7. Jaypee wheat with an additional 50 lb of N per acre, having a stocking density of 500 lb of beef per acre.
8. Jaypee wheat with an additional 50 lb of N per acre, having a stocking density of 750 lb of beef per acre.

The treatments were assigned randomly and were replicated three times each year (Figure 1).

Steers were weighed initially and at 14-day intervals using a 12-hour shrunk weight until the study was terminated. Blood was taken at each weigh period by jugular vein puncture to monitor serum magnesium (Mg) concentrations. Two lb of corn, containing 75 mg of monensin per lb, were fed per steer per day plus bermudagrass hay as needed. In addition, steers had free access to a mineral and vitamin supplement (Table 2). All steers were removed from their respective wheat pastures when the group averaged approximately 750 lb of body weight and were sent to a commercial feedlot. During 1996-97, steers owned by the University of Arkansas were fed at a commercial feed yard (Joe Neill Feedyard, Welch, OK) for 118 days. Data were collected at the packing plant (Iowa Beef Packers, Emporia, KS) for carcass evaluation. During 1997-98 and 1998-99, steers were owned and supplied by a commercial vendor and therefore carcass data could not be obtained.

Two 12’ x 20’ plots in each two-acre pasture were fenced off, using electric fences, before grazing was started, plus two plots were fenced off at the first hollow stem or first jointing in ungrazed wheat and were harvested with a plot combine to determine wheat grain yield. The plots were fertilized with 125 lb of N per acre in the form of urea in early February. Plots were harvested on June 25, 1997, June 15, 1998, and June 30, 1999. Grain yields were calculated using two sub-plots per pastures for each of the three pastures. Due to the late harvesting date in 1999, the wheat was on the ground and the data were not used to determine wheat grain yields for that year.

The remaining wheat forage was grazed with a second set of commercial mixed breed steers during March and April, similar to the fall-winter grazing study.

Table 1. BBCH (European) uniform decimal code for describing morphological development of cereal crops (Stauss, 1994).

Code	Morphological descriptor
Principal growth stage 1: leaf development	
10	first leaf through coleoptile
11 to 18	leaves 1 to 8 unfolded
19	9 or more leaves unfolded
Principal growth stage 2: tillering	
20	no tillers
21	beginning of tillering, first tiller detectable
22 to 28	2 to 8 tillers detectable
29	9 or more tillers detectable
Principal growth stage 3: stem elongation	
30	beginning of stem elongation
31	first node at least 1 cm above tillering node
32 to 38	nodes 2 to 8 detectable
Principal growth stage 4: booting	
41	early boot stage, flag leaf sheath extended
43	mid boot stage, flag leaf sheath just visibly swollen
45	late boot stage, flag leaf sheath swollen
47	flag leaf sheath opening
49	first awns visible
Principal growth stage 5: heading	
51	tip of inflorescence emerged from sheath, first spikelet just visible
53	30% of inflorescence emerged
55	50% of inflorescence emerged
57	70% of inflorescence emerged
59	inflorescence fully emerged
Principal growth stage 6: flowering, anthesis	
61	beginning of flowering, first anthers visible
65	full flowering, 50% of anthers mature
69	end of flowering, all spikelets have completed flowering but some dehydrated anthers may remain
Principal growth stage 7: development of fruit	
71	watery ripe, first grains have reached half their final size
73	early milk
75	medium milk, grain content milky, grains final size, but still green
77	late milk
Principal growth stage 8: ripening	
83	early dough
85	soft dough, grain content soft but dry, fingernail impression not held
87	hard dough, grain content solid, fingernail impression hard
89	fully ripe, grain hard, difficult to divide with a thumbnail
Principal growth stage 9	
92	over-ripe, grain very hard, cannot be dented by thumbnail
93	grains loosening in daytime
97	plant dead and collapsing
99	harvested product

Figure 1. Schematic of pastures and treatment.

East

North

Pasture #		Treatment #		Pasture #		Treatment #
1	Variety: Hickory Nitrogen: 50 lbs/acre Stocking: 500 lbs/acre	7		2	Variety: Jaypee Nitrogen: 0 Stocking: 750 lbs/acre	2
3	Variety: Jaypee Nitrogen: 0 Stocking: 500 lbs/acre	1		4	Variety: Hickory Nitrogen: 0 Stocking: 500 lbs/acre	5
5	Variety: Hickory Nitrogen: 50 lbs/acre Stocking: 750 lbs/acre	8		6	Variety: Jaypee Nitrogen: 50 lbs/acre Stocking: 750 lbs/acre	4
7	Variety: Hickory Nitrogen: 0 lbs/acre Stocking: 750 lbs/acre	6		8	Variety: Jaypee Nitrogen: 50 lbs/acre Stocking: 500 lbs/acre	3
9	Variety: Hickory Nitrogen: 50 lbs/acre Stocking: 500 lbs/acre	7		10	Variety: Jaypee Nitrogen: 50 lbs/acre Stocking: 750 lbs/acre	4
11	Variety: Jaypee Nitrogen: 0 lbs/acre Stocking: 750 lbs/acre	2		12	Variety: Hickory Nitrogen: 50 lbs/acre Stocking: 750 lbs/acre	8
13	Variety: Jaypee Nitrogen: 50 lbs/acre Stocking: 500 lbs/acre	3		14	Variety: Jaypee Nitrogen: 0 lbs/acre Stocking: 500 lbs/acre	1
15	Variety: Hickory Nitrogen: 0 lbs/acre Stocking: 750 lbs/acre	6		16	Variety: Hickory Nitrogen: 0 lbs/acre Stocking: 500 lbs/acre	5
17	Variety: Jaypee Nitrogen: 50 lbs/acre Stocking: 750 lbs/acre	4		18	Variety: Hickory Nitrogen: 0 lbs/acre Stocking: 750 lbs/acre	6
19	Variety: Hickory Nitrogen: 50 lbs/acre Stocking: 500 lbs/acre	5		20	Variety: Jaypee Nitrogen: 0 lbs/acre Stocking: 500 lbs/acre	1
21	Variety: Jaypee Nitrogen: 0 lbs/acre Stocking: 750 lbs/acre	2		22	Variety: Hickory Nitrogen: 50 lbs/acre Stocking: 500 lbs/acre	7
23	Variety: Hickory Nitrogen: 50 lbs/acre Stocking: 750 lbs/acre	8		24	Variety: Jaypee Nitrogen: 50 lbs/acre Stocking: 500 lbs/acre	3

South

West

Table 2. Mineral and vitamin supplement fed free-choice to steers grazing soft red winter wheat forage.

Mineral or vitamin	Level
Calcium (Ca) min.	15.5%
Calcium (Ca) max.	18.5%
Phosphorus (P) min.	5.0%
Salt (Nacl), min.	16.0%
Salt (Nacl), max.	19.0%
Magnesium (Mg)	5.7%
Sulfur (S)	1.3%
Potassium (K)	0.9%
Zinc (Zn)	2400 ppm/lb
Iron (Fe)	2225 ppm/lb
Manganees (Mn)	1600 ppm/lb
Copper (Cu)	800 ppm/lb
Iodine (I)	117 ppm/lb
Cobalt (Co)	40 ppm/lb
Selenium (Se)	12 ppm/lb
Vitamin A	150,000 IU/lb
Vitamin D3	40,000 IU/lb
Vitamin E	50 IU/lb

Financial records were kept for an economic analysis.

Steer growth data for each set of cattle and each year were analyzed by ANOVA procedures of SAS (1988) with a 2x2x2 factorial arrangement of treatments. Data for combined years were analyzed using PROCMIXED of SAS (Littell et. al., 1996) where pasture was a random effect. Sampling data were a repeated effect for serum Mg and years were a repeated effect for gain. Wheat grain yields were analyzed by ANOVA procedures of SAS (1988). All interactions were examined.

Use of animals in this study was approved by the University of Arkansas Institutional Animal Care Committee.

Results and Discussion

I.. Quality of soft red winter wheat forage

The average percentages of crude protein (CP), in vitro dry matter digestibility (IVDMD), neutral detergent fiber (NDF), and acid detergent fiber (ADF) of soft red winter wheat forage as influenced by cultivar of wheat, added nitrogen, stocking density, and month are given in Table 3.

Crude protein was higher ($P<0.05$) in the forage of the cultivar Hickory than in the forage of the cultivar Jaypee, ranging from 29.8 percent in October to 21.3 percent in February for Hickory and 30.3 percent in October to 19.7 percent in February for Jaypee. Crude protein of the forage of both cultivars of soft red winter wheat was exceptionally high, ranging from 20 to 30 percent, depending on the month the forage was sampled. If the 500 lb steers used in this study gained 3 lb per head per day, they would require a diet containing 17 percent CP or 2.05 lb CP/head/d (NRC, 1996). If steers consumed two percent of their body weight in dry matter per day (500 lb steers x .02 body weight = 10 lb dry matter intake per day x 20 percent CP in forage = 2.0 lb CP intake per steer per day), their intake of CP would be great enough to support 3.0 lb per day growth at the lowest level of CP in the forage. Therefore, even though the protein content in the forage of the Hickory Cultivar was significantly ($P < .05$) greater than that of the cultivar Jaypee, both cultivars produced forage which contained ample CP to support 3.0 lb of gain in body weight per head per day.

Acid detergent fiber (ADF) was lower ($P < .01$) in the forage of the cultivar Hickory than in the forage of the cultivar Jaypee, ranging from 18 percent in October to 32 percent in February (18.4, 30.2 vs. 18.8, 31.9 for Hickory and Jaypee, respectively, in October and February). This indicates that the forage of the cultivar Hickory was more digestible than that of the cultivar Jaypee. Even though statistical differences occurred, forage of both cultivars was highly digestible as indicated by the low levels of ADF, and the difference in fiber probably had little, if any, influence on growth of the steers.

There were no differences in NDF or IVDMD of forage due to wheat cultivars. Neutral detergent fiber of wheat forage was 43% during October and rose to 52% during February. In-vitro dry matter digestibility was greater than 90% (93% in October and 95% during February) in both wheat forages, suggesting that the forage supplied sufficient energy to support rapid growth of steers. According to the National Research Council (1996), a 500-lb steer requires a diet containing 80 percent TDN or 9.8 lb TDN to gain 3 lb per day. A steer will normally eat two percent or above of its body weight each day. Thus forage of both cultivars of wheat contains ample CP and TDN to support growth of stocker steers of approximately three lb per head per day.

Added nitrogen (N) at seedling emergence of soft red winter wheat increased ($P < .05$) the CP in the wheat forage. Crude protein was near 30% in October. in both wheat forage which had added N or no added N but was 21.4% and 19.6 % during February in forage which did or did not receive added N, respectively. Even though added N increased ($P < .05$) the CP, forage which received added N or

Table 3. Percentage crude protein (CP), in-vitro dry matter digestibility (IVDMD), neutral detergent fiber (NDF), and acid detergent fiber (ADF) of soft red winter wheat.

Month	Treatment	CP	IVDMD	NDF	ADF
October	Hickory	29.8	92.8	43.4	18.4
	Jaypee	30.3	92.8	42.8	18.8
November	Hickory	26.4	94.0	42.8	19.9
	Jaypee	24.7	94.2	43.1	22.2
December	Hickory	23.8	96.5	43.3	21.2
	Jaypee	23.0	94.8	43.3	22.2
January	Hickory	21.7	93.9	43.2	25.7
	Jaypee	20.2	94.0	44.2	27.7
February	Hickory	21.3	94.8	52.1	30.2
	Jaypee	19.7	95.0	52.6	31.9
October	0 added N	30.2	92.9	43.1	18.7
	50 lb added N/A	26.3	93.9	42.7	20.6
November	0 added N	24.8	94.1	43.2	21.5
	50 lb added N/A	26.3	93.9	42.7	20.6
December	0 added N	22.7	96.2	44.1	21.5
	50 lb added N/A	24.1	96.3	43.4	21.7
January	0 added N	20.1	94.1	44.3	27.7
	50 lb added N/A	21.2	93.8	43.0	25.7
February	0 added N	19.6	94.4	52.6	31.9
	50 lb added N/A	21.4	94.7	52.0	30.1
October	500 lb beef/a	29.8	92.7	43.3	18.5
	750 lb beef/a	30.4	92.8	42.8	18.6
November	500 lb beef/a	25.6	93.7	43.1	20.5
	750 lb beef/a	25.5	94.3	42.8	21.6
December	500 lb beef/a	23.8	96.3	43.7	26.3
	750 lb beef/a	23.1	96.2	43.7	22.7
January	500 lb beef/a	20.8	93.9	43.7	17.7
	750 lb beef/a	20.5	94.1	43.6	25.7
February	500 lb beef/a	21.6	94.7	52.5	31.7
	750 lb beef/a	19.5	95.1	52.3	30.1

did not receive added N had CP at a level to support rapid growth of steers. Added N did not affect ADF, NDF or IVDMD of wheat forage.

Acid detergent fiber percentage was lower (P < 0.01) in grazing treatments with 750 lb beef/acre stocking rate than in grazing treatments with 500 lb beef/acre stocking rate. This was probably due to increased grazing pressure in the higher stocking rate treatment. However, even though these were statistical differences in ADF due to stocking density, the forage of wheat stocked at either 500 or 750 lb per acre was very high in quality and ADF differences probably did not influence rate of growth of the steers. No differences occurred in CP, NDF or IVDMD of wheat forage due to stocking density.

Even though there were differences statistically between quality of forage due to cultivar, added N, and stocking density, the quality of all wheat forage was sufficient to support rapid growth of steers and these differences probably did not influence the rate of growth.

II. Serum Magnesium (Mg)

Serum Mg concentrations of steers which grazed soft red winter wheat forage during 1996-97 and 1997-98 are given in Table 4. Serum Mg concentrations were lower (P<0.01) in steers during 1997-98 than in steers in 1996-97. A cultivar x added nitrogen x stocking density interaction (P<0.05) occurred during November, December, and January. However, even though there were statistical differences, all steers' serum Mg concentrations were within the normal physiological range (1.4 to 3.3 mg/dl) for steers of their body weight (Clarenburg, 1992; Newman and Lusby, 1986). Serum Mg was analyzed for steers during 1998-99 since steers that grazed soft red winter wheat during 1996-97 and 1997-98 had normal physiological blood serum levels of Mg. However, a trace mineral supplement containing Mg is recommended for stocker cattle that graze soft red winter wheat forage.

III. Growth of steers that grazed soft red winter wheat forage during October through February from 1996 to 1999.

A.. The effects of year on average daily gain (ADG), total gain (TG), total gain adjusted to 117 days (117-TG), gain per acre (G/A), and gain per acre adjusted to 117 days (117-G/A) for steers that grazed soft red winter wheat forage.

There were no significant interactions of growth parameters; therefore only main effects were reported The ADG, TG, 117-TG, G/A, and 117-G/A as influenced by year are given in Table 5. There were no differences in ADG, 117-TG or 117 G/A (P>0.13) due to year in which steers grazed soft red winter wheat forage. However, TG and G/A were greater (P<0.01) for steers during 1996-97 than for steers during 1997-98 and 1998-99. Total gain and G/A were greater for steers that grazed soft red winter wheat forage (P<0.01) during 1998-99 than for steers in 1997-98. Steers grazed wheat forage 117 days in 1996-97, 112 days in 1998-99, and only 98 days in 1997-98. Since there were no differences in ADG, 117 TG or 117 G/A, year effect on TG and G/A was due to number of days soft red winter wheat was grazed each year.

B. The effects of cultivars of soft red winter wheat on ADG, TG, 117-TG, G/A, and 117 G/A of steers that grazed wheat forage.

The ADG, TG, 117-TG, G/A, and 117-G/A of steers as influenced by cultivars of soft red winter wheat forage are given in Table 6.

Steers that grazed forage of the cultivar Jaypee had greater ADG, TG, and 117-TG (P<0.01) and produced more G/A and 117-G/A (P<0.01) than steers that grazed forage of the cultivar Hickory. No differences in ADG, TG, 117-TG, and G/A in steers occurred due to cultivar, but steers that grazed forage of the cultivar Jaypee during 1997-98 had higher (P<.01) ADG, TG, 117-TG, G/A, and 117-G/A than those that grazed the forage of the cultivar Hickory. These differences in ADG, TG, and G/A of steers grazing forage of different cultivars of soft red winter wheat are consistent with results observed in other studies (Daniels et al., 1999, 2000)., (Horn et al., 1994), (Gribble and Krenzer, 1994). Jaypee may have produced more total forage than Hickory, especially during 1997-98. Jaypee lacks cold and wet soil tolerance and produces more forage during mild environmental temperatures, which occurred during 1997-98. Mean high and low temperatures and rainfall by month are shown in Table 7 for years 1996-97, 1997-98, and 1998-99. Forage availability did not appear to be limited either year. Chemical analyses suggest that Jaypee forage may be more palatable than forage of Hickory; forage of Hickory was higher in CP and lower in ADF than Jaypee, but gains were greater for steers grazing Jaypee.

C. The effects of added nitrogen on ADG, TG, 117-TG, G/A, and 117-G/A of steers that grazed wheat forage during 1996-97, 1997-98, and 1998-99.

The effects of added nitrogen on ADG, TG, 117-TG, G/A or 117-G/A of steers that grazed soft red winter wheat forage from October through February during 1996-97, 1997-98, and 1998-99 are shown in Table 8.

There were no differences in ADG due to added N at time of seedling emergence. Gribble and Krenzer (1994) reported that for every 100 lb of livestock gain when cattle grazed hard red winter wheat forage. If one applies this rationale to soft red winter wheat forage, approximately 100 lb N/acre would have been required in the present study. Soil N of the pastures in the present study averaged 146 lb N/a where no additional N was added and 175 lb N/a when 50 lbs N/a were added. Thus, it appears that adequate N was available without adding additional N.

There were no differences in TG or 117-TG observed from added N to the wheat at seedling emergence. Ample soil N appeared to be present. Total gain in this study was greater than that reported by Horn et al. (1994) for steers that grazed hard red winter wheat.

No differences occurred in G/A or 117-G/A because of added N at seedling emergence. Therefore, soil N appeared not to be limited in this study.

No benefit was obtained by adding N at seedling emergence since soil N was already high. However, the addition of

Table 4. Serum magnesium (Mg) concentration of steers that grazed soft-red winter wheat forage during fall and winter (mg/dl).

		Cultivar		Nitrogen		Stocking density	
Year	Month	Hickory	Jaypee	0-N	50 lb/A	500 lb/A	750 lb/A
1996-97	October	2.5	2.5	2.5	2.5	2.5	2.6
1997-98		2.1	2.2	2.1	2.2	2.2	2.1
AV		2.3	2.4	2.3	2.3	2.3	2.4
1996-97	November	2.5	2.5	2.6	2.5	2.5	2.6
1997-98		2.4	2.4	2.4	2.5	2.5	2.4
Av		2.5	2.5	2.5	2.5	2.5	2.5
1996-97	December	2.4	2.4	2.4	2.4	2.4	2.4
1997-98		2.1	2.1	2.1	2.2	2.1	2.1
Av		2.3	2.3	2.3	2.3	2.3	2.3
1996-97	January	2.4	2.4	2.4	2.4	2.4	2.4
1997-98		2.0	2.0	2.0	2.0	2.0	2.0
Av		2.2	2.2	2.2	2.2	2.2	2.2

Table 5. The effects of year on average daily gain (ADG), total gain (TG), total gain adjusted to 117 day (117-TG), gain per acre (GA), and gain per acre adjusted to 117 days (117-G/A) of steers that grazed soft red winter wheat forage during 1996-1999.

Year	Days	ADG	TG	117-TG	G/A	117-G/A
		-----------------	-----------------	%	-----------------	-----------------
1996-97	117	2.35	276.7a	275.7	341.3	340.7
1997-98	98	2.38	233.8c	277.7	287.8c	343.3
1998-99	112	2.24	252.0b	263.4	311.3	325.1
SE		0.04	5.2	3.7	6.7	7.41
P-value		0.29	<0.01	0.14	<0.01	0.17

Table 6. The effects of cultivar on average daily gain (ADG, total gain (TG), total gain adjusted to 117 days (117 TG), gain per acre (G/A), and gain per acre adjusted to 117 days (117-G/A) of steers that grazed soft red winter wheat forage during October through February during 1996 to 1999.

Cultivars	Days	ADG	TG	117-TG	G/A	117 G/A
		-----------------	-----------------	%	-----------------	-----------------
Hickory	109	2.24	246.8	261.8	302.0	323.1
Jaypee	109	2.42	263.7	283.5	325.0	349.6
SE		0.04	4.3	4.7	5.5	6.1
P-value		<0.01	<0.01	<0.01	<0.01	<0.01

Table 7. Average high and low temperatures and rainfall during September through August for 1996-1997, 1997-98, and 1998-99.

	1996-97			1997-98			1998-99		
Month	High (°F)	Low (°F)	Rainfall (in.)	High (°F)	Low (°F)	Rainfall (in.)	High (°F)	Low (°F)	Rainfall (in.)
September	82	61	6.33	91	59	2.97	92	66	2.91
October	75	49	2.73	75	50	3.48	77	52	5.80
November	54	37	12.61	57	49	1.99	65	44	2.65
December	54	34	2.74	50	32	3.46	53	33	2.55
January	51	28	1.72	53	35	4.61	51	32	5.12
February	56	36	5.36	57	37	3.38	61	38	0.92
March	69	41	5.25	57	39	6.92	60	38	5.59
April	70	45	6.13	74	47	3.77	74	55	4.59
May	80	52	3.70	87	62	2.00	82	56	2.80
June	87	65	1.77	93	70	1.54	89	66	2.69
July	90	70	1.76	100	73	2.95	93	66	4.08
August	90	62	1.28	92	67	4.32	96	67	2.47
Total Rainfall			51.38			41.39			42.17
Average Nov. – Feb.	54	34	5.61	54	38	3.36	57	37	2.81
Average March – April	69	43	5.69	65	43	5.34	67	46	5.09

Table 8. The effect of added nitrogen at seedling emergence on ADG, TG, 177-TG, G/A, and 117-G/A of steers that grazed soft red winter wheat forage from October through February during 1996-97, 1997-98, and 1998-99.

Nitrogen level	Days	ADG	TG	117-TG	G/A	177 G/A
		-----	-----	%	-----	-----
0	109	2.29	250.1	268.5	308.1	330.8
50	109	2.38	258.3	276.8	318.9	341.9
SE		0.04	4.3	4.73	5.55	6.13
P-value		0.22	0.18	0.22	0.18	0.20

N when cattle are grazing needs to be evaluated based on soil tests.

D. The effects of stocking density on ADG, TG, 117-TG, GA, and 117-G/A of steers that grazed wheat forage during 1996-97, 1997-98, and 1998-99.

The effects of stocking density on ADG, TG, 117 TG, G/A, and 117 G/A of steers that grazed forage of soft red winter wheat during October through February for the years 1996-97, 1997-98, and 1998-99 are given in Table 9.

Average daily gain was greater (P<0.01) in steers that grazed soft red winter wheat forage from October through February at a stocking density of 500 lb beef per acre than in those steers that grazed soft red winter wheat forage at a stocking density of 750 lb beef per acre. This difference in ADG was probably due to forage availability since more grazing pressure occurred in pastures with the higher stocking density. Horn (1994) and Horn et al. (1994) reported that ADG of steers decreases as stocking density increases above 300 lb beef/acre when steers graze hard red winter wheat forage during the fall and winter. In the present study the stocking density exceeded 300 lb beef per acre by 1.7 and 2.5 times for stocking densities of 500 and 750 lb beef/acre, respectively.

Steers that grazed soft red winter wheat forage, with a stocking density of 500 lb beef per acre, had a greater (P < 0.01) TG and 117-TG than steers that grazed wheat pastures having a stocking density of 750 lb beef per acre. These higher TG and 117-TG values were due to higher ADG of steers having the lower stocking density. Total gain in the present study was greater than that reported by Horn et al. (1994) for steers that grazed hard red winter wheat forage. However, stocking densities in the present study were two and three times (500 and 750 lb beef/acre compared to 250 lb beef per acre) greater than that used by Horn et al. (1994) for steers grazing hard red winter wheat forage.

Steers that grazed soft red winter wheat forage stocked at a density of 750 lb of beef per acre produced more (P < 0.01) G/A and 117-G/A than steers at a stocking density of 500 lb beef per acre even though they had lower (P<0.01 ADG (2.2 vs 2.5 lbs, respectively). Steers stocked at a density of 750 lb beef per acre gained 355 lbs per acre (381 lb for 117-G/A) as compared to 272 lb beef/acre (292 lbs for 117 G/A). Horn et al. (1994) observed that G/A increased as stocking density increased when steers grazed hard red winter wheat forage. Gain per acre in our study was much greater for steers that grazed hard red winter wheat forage than that found by Horn et al. (1994). This was due to a much higher stocking density in the present study (500 and 750 lbs beef per acre) as compared to (250 lbs beef per acre) that was used by Horn et al. (1994).

Steers that were stocked at a density of 500 lbs of beef per acre had greater ($P<0.05$) total gains per head than those steers that were stocked at a density of 750 lbs of beef per acre. However, pastures that had a stocking density of 750 lbs of beef per acre produced more ($P<0.05$) lbs of beef per acre than those having a stocking density of 500 lbs of beef per acre.

IV. Growth of steers that grazed soft red winter wheat during March and April, 1998 and 1999.

A. The effects of year on ADG, TG, and G/A of steers that grazed soft red winter wheat forage in March and April during 1998 and 1999 are shown in Table 10. During 1998 steers had greater ADG and TG ($P < .01$) and produced more beef per acre ($P < .01$) than those in 1999. This was primarily due to differences in forage quality and availability. February and the first three weeks of March in 1999 were very dry (0.92 inches of rainfall during February and less than one inch during the first three weeks of March), resulting in reduced forage growth. In addition the temperature was warmer during February and March (especially night temperature) resulting in earlier maturity of the wheat during 1999 than during 1998.

B. The effects of cultivar on ADG, TG and G/A of steers that grazed soft red winter forage during March and April in 1998 and 1999 are shown in Table 11. There were no differences in ADG, TG, or G/A of steers due to cultivar of soft red winter wheat. This is different than growth of steers during October through February where steers that grazed Jaypee had greater ADG and TG and produced more beef per acre than those that grazed of Hickory.

C. The effects of added nitrogen at seedling emergence on ADG, TG, and G/A of steers that grazed soft red winter wheat forage during March and April 1998 and 1999 are shown in Table 12. There were no differences in ADG, TG, or G/A of steers that grazed soft red winter wheat forage due to addition of nitrogen at seedling emergence during 1998 and 1999. According to calculations of Gribble and Krenser (1994), adequate nitrogen existed in the soil in the present study.

D. The effects of stocking density on ADG, TG, and G/A of steers that grazed soft red winter wheat during March and April in 1998 and 1999 are shown in Table 13. Average daily gain and total gain of steers stocked at a density of 500 lb beef/acre were greater ($P < .05$) than of those stocked at a density of 750 lb beef per acre. Horn et al. (1994) reported that as stocking density increases when steers graze hard red winter wheat forage, ADG and TG is lowered but G/A increases. In the present study, steers stocked at 750 lb beef/acre produced more ($P < .01$) G/A than those stocked at 500 lb beef/acre. The stocking densities used in the present study for grazing soft red winter wheat forage are approximately two and three times greater than those reported for grazing hard red winter wheat forage.

V. Feedlot and carcass data of steers that had grazed soft red winter wheat.

The performance and carcass data of steers that grazed soft red winter wheat forage from October through February during 1996-97 are shown in Table 14. Steers gained 3.65 pounds per head per day and had a feed conversion rate of 6.1 lbs. dry feed per pound of grain while in the feedlot. Daily cost in the feedlot was $2.16 per head. Seventy-three percent of the steers graded choice and 27 percent graded select. Yield grade of 3.25 was slightly high indicating overfinishing and suggesting that the steers may have been fed too long. There were no differences in steer performance or carcass analysis because of cultivar of wheat, adding nitrogen to wheat, or stocking density of steers that grazed soft red winter wheat. Performance of steers in the feedlot and carcass data were excellent.

VI. Wheat grain yields.

Grain yields for soft red winter wheat which was grazed from October until first hollow stem or first jointing of ungrazed wheat are given in Table 15. Weather conditions, infestation of rye grass, and lateness of harvesting prevented data collection for wheat grain yields in 1999. There were no significant interactions on grain parameters; therefore only main effects are reported.

Higher grain yields ($P<0.01$) were observed when wheat was grazed than when it was not grazed. Ungrazed wheat contained a large amount of blank heads, which indicated freeze damage. Since the wheat was planted on September 10 and 11, it was in stage 29 (Stauss, 1994) when freezing weather occurred in winter and jointed early in the spring when freezing was still occurring. Thus, if wheat is planted in early September, grazing enhances grain yields. Yields from wheat that was grazed were near the state average for wheat grain production of wheat planted in October and November and ungrazed (Klugh, 1999). There was also considerable variation within treatments of wheat grain yields. Most of this variation was attributed to an infestation by ryegrass. No herbicide was applied to wheat during the fall to control ryegrass. No fungicide was applied to control fungal diseases, which affect wheat grain production.

No difference in wheat grain yield occurred when wheat was grazed until first hollow stem (approximately March 1) or first jointing of ungrazed wheat (approximately March 15)

Table 9. The effect of stocking density on ADG, TG, 177-TG, G/A, and 117-G/A of steers that grazed soft red winter wheat forage from October through February during 1996-97, 1997-98, and 1998-99.

Stocking density	Days	ADG	TG	117-TG	G/A	177 G/A
		---lb---				
500 lb beef/a	109	2.49	271.9	291.5	271.9	291.6
750 lb beef/a	109	2.18	236.4	253.4	355.1	381.2
SE		0.04	4.29	4.71	5.52	5.95
P-value		<0.01	<0.01	<0.01	<0.01	<0.01

Table 10. The effect of year on ADG, TG, and G/A of steers that grazed soft red winter wheat during March and April during 1998 and 1999.

Year	Days	ADG	TG	G/A
		---lb---		
1998	44	3.17	139.2	175.5
1999	42	2.09	87.0	103.9
SE		0.09	3.72	5.10
P-value		<0.01	<0.01	<0.01

Table 11. The effect of cultivar on ADG, TG, and G/A of steers that grazed soft red winter wheat during March and April during 1998 and 1999.

Cultivar	Days	ADG	TG	G/A
		---lb---		
Hickory	43	2.66	114.4	139.8
Jaypee	43	2.55	111.8	138.6
SE		0.09	3.76	5.16
P-value		0.55	0.25	0.24

Table 12. The effects of added nitrogen at seedling emergence on ADG, TG, and G/A of steers that grazed soft red winter wheat during March and April during 1998 and 1999.

Added nitrogen	Days	ADG	TG	G/A
		---lb---		
0	43	2.71	116.2	143.6
50	43	2.55	110.0	134.8
SE		0.09	3.78	5.21
P-value		0.22	0.25	0.24

Table 13. The effect of stocking density on ADG, TG, and G/A of steers that grazed soft red winter wheat during March and April during 1998 and 1999.

Stocking density	Days	ADG	TG	G/A
		---lb---		
500 lb beef/a	43	2.75	118.9	118.5
750 lb beef/a	43	2.49	107.3	160.0
SE		0.08	3.23	5.21
P-value		<0.04	<0.04	<0.01

Table 14. Feedlot performance and carcass data for steers fed from 1997 that grazed soft red winter wheat forage from October 23, 1996 to February 17, 1997.

Item	Amount
Number of steers	60
Breeding of steers	Angus x Brangus
Entering weight (lb)	746
Final weight (lb)	1,188
Days on feed	121
ADG (lb)	3.65
Dryfeed/lb gain	6.10
Cost/head/day	$2.16
Hot carcass weight (lb)	741
Dressing percentage	62.4
Yield grade	3.25
Ribeye area (in)	12.32
Percentage choice carcass	73
Percentage select carcass	27

Table 15. Grain yields of soft red winter wheat that was ungrazed, or cattle were removed at first hollow stem (HS) or first jointing (J) in ungrazed wheat during 1996-97 and 1997-98.

Treatment	0	HS	J
	---------------------(bu/a)---------------------		
1	29.9a*	54.1b	47.8b
2	20.2a	54.4b	49.8b
3	26.0a	34.1b	29.8b
4	7.4a	27.0b	30.9b
5	31.9a	52.4b	56.6b
6	24.9a	34.3b	45.9b
7	28.2a	53.7b	44.3b
8	24.6a	39.4b	35.9b
Average	24.4a	44.1b	42.6b

*Means within lines with different letters differ at the (P <.01) level of significance.

by stocker cattle (Table 15). These data differ from those of Krenzer et al. (1996) who reported a grain yield decrease in hard red winter wheat when grazing occurred after the first hollow stem in ungrazed wheat. These data suggest no reduction in wheat grain yield when cattle are removed by first hollow stem of ungrazed wheat or little if any reduction in wheat grain yield when cattle are removed from grazing by first jointing in ungrazed wheat.

There were no differences between wheat cultivars for grain yields (Table 16). The addition of 50 lbs of added nitrogen per acre at seedling emergence (Table 17) produced lower grain yields (P<0.01).

Grain yields were greater (P<0.05) at the lower stocking density than at the higher stocking density (Table 18). This reduction of grain yields at the higher stocking density was probably due to slower recovery of the wheat plants in the spring. Tillering also may have been reduced. These data suggest that at the higher stocking density, the wheat was probably overgrazed and spring recovery was not sufficient to produce maximal yields compared to those of wheat stocked at the lower density.

VII. Economics of production systems involving stocker cattle and soft red winter wheat.

Average grain production costs-per-acre for soft red wheat cultivars, Hickory and Jaypee, are presented in Table 19. These costs included soil preparation, seeding, fertilization, seed cost, chemicals, harvesting, and hauling. Total costs of production of Hickory and Jaypee were $151.17 and $147.93/acre, respectively. The difference was the cost of seed of the Hickory Cultivar. These production costs-per-acre of wheat are similar to the cost of production per acre of soft red winter wheat grown for grain by the average wheat farmer in Arkansas.

The production costs-per-acre, excluding forage costs, for production of stocker cattle that grazed soft red winter wheat forage from October through February are shown in Table 20. Costs of labor and maintenance for the production of

Table 16. Wheat grain yields of the cultivars Hickory or Jaypee when ungrazed (0) or when cattle were removed from grazing by the first hollow stem (HS) or jointing (J) of ungrazed wheat during 1996-97 and 1997-98.

	1996-97		1997-98		1996-98 average	
Treatment	Hickory	Jaypee	Hickory	Jaypee	Hickory	Jaypee
	(bu/a)					
0	24.7	21.4	26.3	18.7	25.5	20.0
HS	45.7	42.4	40.9	35.2	43.3	38.8
J	39.6	45.7	36.9	34.7	38.3	40.2

Table 17. Wheat grain yields as influenced by no added nitrogen (0-N) or 50 pounds per acre added nitrogen (50-N) when wheat was ungrazed (0) or when cattle were removed from grazing wheat at the first hollow stem (HS) of ungrazed wheat or first jointing (J) of ungrazed wheat during 1996-97 and 1997-98.

	1996-97		1997-98		1996-98 average	
Treatment	0-N	50-N	0-N	50-N	0-N	50-N
	(bu/a)					
0	26.7a*	21.5b	25.3a	19.7b	26.0a	20.6b
HS	44.5a	38.5b	39.3a	36.8b	41.9a	37.6b
J	50.0a	35.2b	41.5a	36.6b	45.8a	36.0b

*Means of lines with columns having different letters differ at the (P<.01) level of significance.

Table 18. Wheat grain yields as influenced by stocking density when wheat was ungrazed, cattle removed at first hollow stem in ungrazed wheat, or at first jointing in ungrazed wheat during 1996-97 and 1997-98.

	1996-97		1997-98		1996-98 average	
Treatment	500/a	750/a	500/a	750/a	500/a	750/a
	(bu/a)					
0	29.0a*	19.3b	26.5a	19.4b	27.7a	19.3b
HS	48.6a	39.5b	45.5a	30.6b	47.0a	35.0b
J	44.6a	40.6b	45.1a	33.0b	44.8a	36.8b

*Means of lines with columns having different letters differ at the (P<.05) level of significance.

Table 19. Three year average cost-of-production of Hickory and Jaypee cultivars of soft red winter wheat for grain.

Labor and operating cost	Hickory	Jaypee
	$/a	
Disking	14.29	14.29
Fertilizer spreading	5.18	5.18
Grain drilling	8.11	8.11
Spraying	2.80	2.80
Rolling	4.26	4.26
Round-up	5.40	5.40
Wheat seed	19.20	15.96
Lime	11.60	11.60
Fertilizer	22.50	22.50
Sub-total	93.34	90.10
Spring urea	27.17	27.17
Fertilizer spreading	2.59	2.59
Custom combining	21.32	21.32
Custom hauling	6.75	6.75
Sub-total	57.83	57.83
Total	151.17	147.93

stocker cattle were $39.63 and $53.87 for stocking densities of 500 and 750/a, respectively. If transportation costs of shipping cattle to the feedlot are included, an additional cost of $15.00 and $22.50/a for stocking densities of 500 and 750 lb/a, respectively, is added making the total cost of $54.63 and $76.37/a for stocking densities of 500 and 750 lb beef/a, respectively. Forage costs were $104.21 and $100.97 for Hickory and Jaypee cultivars, respectively (Table 21).

Economic analysis of stocker cattle production when soft red winter wheat forage was grazed from October through February during 1996-1999 is shown in Table 21. Income over the cost of forage and non-forage expenses per acre for stocker cattle ranged from $69.03 to $103.30 depending on cultivar of wheat and the stocking density of cattle. Average income over expenses per acre was $87.73 and $86.10 for Hickory and Jaypee, respectively. Average income above expenses for cattle having a stocking density of 500 and 750 lb/a was $70.60 and $103.23, respectively. Income over expenses per head averaged $70.52 and $68.90 for Hickory and Jaypee, respectively, whereas it was $70.60 and $68.82 for stocking densities of 500 and 750 lb/a. Cost per lb of gain averaged $0.50 and $0.49 for Hickory and Jaypee, respectively, and $0.52 and $0.47 for stocking densities of 500 and 750 lb beef/a.

Returns over expenses of wheat grain production are shown in Table 22. Since there were no significant differences in wheat grain yield due to time the cattle were removed from the wheat and wheat yields were essentially state average (45 bu/a), 45 bushels/a of wheat grain with a selling price of $3.50/a were used in this economic scenario. Income over expenses per acre when all expenses were charged to grain was $6.33 for Hickory and $9.57 for Jaypee. If one received $4.00/bu for wheat grain, income over expenses would have been $28.83 and $32.07 for Hickory and Jaypee, respectively. If average wheat grain yields were increased to 55lb/a, income over expenses would have been $41.33 and $44.56 for Hickory and Jaypee, respectively. If average wheat grain yield were increased to 55 bu/a income over expenses would have been $41.33 & $44.57 for Hickory and Jaypee, respectively, when selling price was $3.50/bu and $68.83 and $72.07 when the selling price of wheat was $4.00/bu. Therefore, there is a good potential of making money from stocker cattle when wheat grown for grain is grazed.

An economic analysis of a stocker cattle-wheat grain production system when steers grazed wheat forage from October through February, 1996-1999, and wheat grain was harvested in June is shown in Table 23. Selling price of cattle was $75/cwt and $3.50 per bushel for wheat grain. Income over expenses/a ranged from $176.33 for Jaypee stocked at 500 lb beef/a to $213.84 for Hickory stocked at 750 lb beef/a. Average income above expenses for Hickory and Jaypee was $198.27 and $193.39, respectively. Income above expenses was $179.51 and $212.15/a for stocking densities of 500 and 750 lb beef/a. Thus, excellent returns were made when stocker cattle grazed soft red winter wheat forage from October through February and wheat was then harvested in June. Average income above expenses was $198.93/a.

An economic analysis scenario looking at net returns from cattle grazing soft red winter wheat forage from October through February, 1996-1999, is shown in Table 24. Purchase cost of steers was based on either $85, $80 or $75/cwt, selling price of steers was $75/cwt, and selling price of wheat grain was $3.50/bu. When purchase price of steers was $85/cwt, net return per acre ranged from $129.57 for Jaypee stocked at 500 lb beef/a to $138.70 for Jaypee stocked at 750 lb beef/a. Average net income per acre was $134.20. When purchase cost of steers was $75/cwt, net income per acre averaged $196.70/a. Thus, a wheat farmer having 200 acres of wheat has the potential to net from $26,840 to $39,340 per year. Increase in selling price of cattle or wheat would change this scenario. Therefore, these data suggest that the potential to increase net income from wheat greatly increases if it is planted in early September and grazed with stocker cattle from October through February. An economic analysis of stocker cattle that grazed soft red winter wheat from March through April, 1997-99, with a selling price of steers of $75/cwt is shown in Table 25. Income over expenses per acre ranged from $59.66 for Hickory stocked at 500 lb beef/a to $84.10 for Jaypee stocked at 750 lb beef/a. Average returns above expenses were $71.51 and $72.07 for Hickory and Jaypee, respectively, and $59.85 and $83.75 for stocker densities of 500 and 750 lb beef/a, respectively.

Economics of stocker cattle that grazed soft red winter wheat from October through April, 1996-99, based on a selling price of steer at $75/cwt are shown in Table 26. Income above expenses per acre ranged from $128.95 for Jaypee stocked at 500 lb beef/a to $187.51 for Jaypee stocked at 750 lb beef/a. Average income over expenses per acre was $159.64 and $158.23 for Hickory and Jaypee, respectively, and $131.29 and $187.07 when stocked at 500 or 750 lb beef/a, respectively.

Given in Table 27 is a scenario of purchasing cattle at $85, $80 or $75/cwt, grazing soft red winter wheat forage from November through April, and selling steers at purchase and selling price of cattle. Average net return/a when cattle were purchased at $85, $80, and $75/cwt were $33.80, $93.32, and $158.87, respectively.

Economics of harvesting soft red winter wheat forage with two sets of stocker cattle as compared to harvesting wheat forage with cattle from October through February and then harvesting wheat grain in June are given in Table 28. Harvesting wheat forage with cattle only was not as profitable as harvesting wheat forage with cattle plus harvesting a wheat grain crop. Price of cattle and or price of yield of wheat grain affect this scenario.

Conclusions

Soft red winter wheat produces forage of exceptionally high quality for stocker cattle when planted on a prepared seed bed in early September and grazed from October through April. Average daily gains of stocker cattle are approximately 2.5 lb while grazing soft red winter wheat during this period. Grazing of wheat does not reduce grain yields if cattle are removed by first jointing of ungrazed wheat. More net profit occurred when wheat forage was grazed from October until March 1 and then wheat grain was harvested in June ($134.20/a) when compared to grazing from October through April ($30.80/a). Cattle that grazed soft red winter wheat forage from October through February performed well in the feedlot, averaging 3.65 lb of gain/day on 6.1 lb of feed per lb gain with 72% grading choice. Wheat farmers in Arkansas should consider planting wheat in early September, grazing it with stocker cattle, and then harvesting wheat grain. The income from the cattle will more than pay for the production of wheat grain. Therefore, net profit per acre could be greatly increased with over one million stocker cattle available in Arkansas and surrounding states; agricultural income in the state could be increased by approximately $75,000,000 dollars from stocker cattle production. Utilization of soft red winter wheat forage by stocker cattle has great potential in Arkansas and surrounding states.

Literature Cited

Clarenburg, R. 1992. Physiological chemistry of domestic animals. Mostly Year Book, Inc. St. Louis, MO.

Daniels, L.B., K.F. Harrison, D. Hubbell, III, Z.B. Johnson, A.H. Brown, Jr., L. Ashlock, T. Windham, R. Bacon, E.B. Kegley, W. Coblentz and K. Coffey. 1999. Production systems involving stocker cattle, soft red winter wheat and soybeans. Proc. Stocker Cattle for Arkansas Conference. Batesville, AR.

Daniels, L.B., K.F. Harrison, D. Hubbell, III, Z.B. Johnson, A.H. Brown, Jr., E.B. Kegley, W.K. Coblentz and K.P. Coffey. 2000. Evaluation of eight cultivars of soft red winter wheat for forage for stocker cattle production. Arkansas Animal Science Report. Ark. Agri. Experiment Sta. Res. Series 472, p 72.

Gribble, R.V. and E. Krenzer. 1994. Maximizing wheat forage production. Proc. Of Wheatland Stocker Conf. Enid, OK. Pp B-1.

Horn, G.W. 1994. Supplementation strategies for wheat pasture stocker cattle. Proc. Of Wheatland Stocker Conf. Enid, OK. Pp E-1.

Horn, G.W., G. Krenzer, D. Bernardo, L. Redman and J. Andrae. 1994. Evaluation of wheat varieties in the wheat grain/stocker cattle enterprise. Proc. Of the Wheatland Stocker Conf. Enid, OK. Pp D-1.

Klugh, B.F. Jr. 1999. Arkansas Agricultural Statistics for 1999. Ark. Agri Expt. Station. Pp. 402.

National Research Council. 1996. Nutrient Requirements of Beef Cattle. 7th Ed. National Academy of Sciences.

Krenzer, E., D.J. Bernardo, L.A. Redmond and G.W. Horn. 1994. Grazing termination date effects on grain yield and net returns per acre of semi-dwarf winter wheat . Proc. Wheatland Stocker Conf. Enid, OK Pp F-1.

Littell, R.C., G.A. Milliken, W.W. Stroup and R.D. Wolfinger. 1996. Systems for mixed models. SAS Institute, Inc. Cary, NC.

Neuman, A.L. and L.S. Lusby. 1986. Beef Cattle, 8th Ed. John Wiley and Sons, Inc. New York, NY.

Taylor, R.E. 1994. Beef production and management decisions. 2nd Ed. McMillian Publishing Co. New York, NY.

SAS. 1998. SAS/STAT user's guide (Release 6.03), SAS Institute, Inc. Cary, NC.

Stauss, R. 1994. Compendium of growth stage identification keys for mono and dicotyledonous plants. Extended BBCH scale. Compiled by Reinhold Stauss. Ciba Geigy AG, Basel, Switzerland.

Table 20. Three year average cost for feed and maintenance of stocker cattle that grazed wheat forage having a stocking density of 500 and 750 lb beef per acre during October through February, 1996-1999.

Item	500 lb/a	750 lb/a
	-------------------$/a-------------------	
Electric fence	5.00	5.00
Corn	15.75	23.66
Hay	4.48	6.72
Labor	3.20	3.20
Water	3.02	3.02
Minerals and Monensin	4.90	7.35
Vet and medical	3.28	4.92
Sub-total	39.63	53.87
Hauling to feedlot	15.00	22.50
Total	54.63	76.37

Table 21. Economic analysis of stocker cattle production while grazing soft red winter wheat forage during October through February, 1996-1999, based on $75/cwt selling price of cattle.

	Hickory		Jaypee	
Item	500 lb/a	750 lb/a	500 lb/a	750 lb/a
Total gain, lb/a	308.00	378.50	299.50	374.00
Return, $/a	231.00	283.88	224.63	280.50
Total non-forage cost, $/a	54.63	76.37	54.63	76.37
Return, $/a	176.37	207.51	170.00	204.13
Forage cost, $/a	104.21	104.21	100.97	100.97
Income over expenses, $/a	72.16	103.30	69.03	103.16
Income over expenses, $/H	72.16	68.87	69.03	68.77
Cost per lb gain, $	0.52	0.48	0.52	0.47

Table 22. Economic analysis of soft red winter wheat that was grazed by stocker cattle from October through February, 1996-1999, and harvested for grain based on $3.50/bu selling price of wheat grain and assuming all production costs were for grain.

	Hickory		Jaypee	
Item	500 lb/a	750 lb/a	500 lb/a	750 lb/a
Wheat grain yield, bu/a	45	45	45	45
Cost of production, $/a	151.17	151.17	147.93	147.93
Income, $/a	157.50	157.50	157.50	157.50
Income over expenses $/a	6.33	6.33	9.57	9.57

Table 23. Economic analysis of a stocker cattle–wheat grain production system where steers grazed wheat forage from October through February, 1996-1999, followed by harvesting wheat grain (selling price of cattle was $75/cwt and wheat $3.50/bu).

	Hickory		Jaypee	
Item	500 lb/a	750 lb/a	500 lb/a	750 lb/a
Income from cattle, $/a	231.00	283.88	224.63	280.50
Income from wheat, $/a	157.50	157.50	157.50	157.50
Total income, $/a	388.50	441.38	382.13	438.00
Expenses: $/a				
Non-forage	54.63	76.37	54.53	75.37
Cost of wheat production	151.17	151.17	151.17	151.17
Total expenses	205.80	227.54	205.80	227.54
Income over expenses, $/a	182.70	213.84	176.33	210.46
Income over expenses, $/h	182.70	142.56	176.33	140.31

Table 24. Net return when cattle grazed soft red winter wheat forage from October through February, 1996-1999, with a purchase cost of steer being either $85, $80, or $75/cwt and selling price of wheat grain being $3.50/bu.

	Hickory		Jaypee	
Item	500 lb/a	750 lb/a	500 lb/a	750 lb/a
Income, $/a				
Steers	606.00	846.38	599.63	843.00
Wheat grain	157.50	157.50	157.50	157.50
Total income, $/a	763.50	1003.88	757.13	1000.50
Expenses: $/a				
Purchase of steers, $85/cwt	425.00	637.50	425.00	637.50
Purchase cost of steer $80/cwt	400.00	600.00	400.00	600.00
Purchase cost of steer, $75/cwt	375.00	562.50	375.00	562.50
Non-forage cost, $/a	54.63	76.37	54.63	75.37
Grain & forage costs, $/a	151.17	151.17	147.93	147.93
Total cost feed, forage and grain $/a	205.80	227.54	202.56	224.30
Net income $/A				
Purchase cost of steers, $85/cwt	132.76	135.84	129.57	138.70
Purchase cost of steers, $80/cwt	157.70	173.34	154.57	176.20
Purchase cost of steers, $75/cwt	182.70	210.84	179.77	213.70

Table 25. Economics of stocker cattle that grazed soft red winter wheat forage from March through April, 1997-1999, based on a selling price of cattle of $75/cwt.

	Hickory		Jaypee	
Item	500 lb/a	750 lb/a	500 lb/a	750 lb/a
Gain lb/a	118.50	160.00	119.00	161.00
Income, $/a	88.88	120.00	89.25	120.75
Expenses: $/a				
Urea	10.87	10.87	10.87	10.87
Corn	8.40	12.60	8.40	12.60
Fence	2.50	2.50	2.50	2.50
Labor	1.50	1.50	1.50	1.50
Water	1.50	2.50	1.50	2.50
Mineral	2.45	3.68	2.45	3.68
Vet and Medical	2.00	3.00	2.00	3.00
Sub-Total	29.22	36.68	29.22	36.65
Income Over Expenses, $/a	59.66	83.35	60.03	84.10
Income Over Expenses $/h	59.66	55.57	60.03	56.07

Table 26. Economic analysis of a stocker cattle production system using soft red winter wheat forage based on a $75/cwt selling price during 1996-1999.

	Hickory		Jaypee	
Item	500 lb/a	750 lb/a	500 lb/a	750 lb/a
Income, $/a				
Returns from cattle (fall) $/a	232.80	284.24	224.52	280.50
Returns from cattle (spring) $/a	88.88	120.00	89.25	120.75
Total income	321.68	404.24	313.77	401.25
Expenses:				
Non-forage cost (fall) $/a	54.63	76.37	54.63	76.37
Non-forage cost (spring) $/a	18.35	25.53	18.35	25.53
Forage cost (fall) $/a	104.21	104.21	100.97	100.97
Forage cost (spring) $/a	10.87	10.87	10.87	10.87
Total expenses	188.06	217.58	184.82	213.74
Income over expenses $/a	133.62	186.66	128.95	187.51
Income over expenses $/h	133.62	124.44	128.95	125.00

Table 27. Income over expenses per acre of stocker cattle that grazed soft red winter wheat forage from October through April.

	Hickory		Jaypee	
Item	500 lb/a	750 lb/a	500 lb/a	750 lb/a
Total income, $/a	1069.88	1528.88	1063.88	1525.25
Expenses:				
Forage costs, $/a	115.08	115.08	111.84	111.84
Non-forage costs, $/a	72.98	101.90	72.98	101.90
Animal purchase cost, $75/cwt	750.00	1125.00	750.00	1125.00
Animal purchase cost, $80/cwt	800.00	1200.00	800.00	1200.00
Animal purchase cost, $85/cwt	850.00	1275.00	850.00	1275.00
Income over expenses $/a:				
Purchase cost $75/cwt	131.82	186.90	129.06	186.51
Purchase cost $80/cwt	81.82	111.90	79.06	111.51
Purchase cost $85/cwt	31.82	36.90	29.06	37.41

Table 28. Economic scenario of harvesting soft red winter wheat forage from October through April with stocker cattle, harvesting winter wheat from October through February with stocker cattle, and then harvesting wheat grain in June or only harvesting wheat grain.

	Hickory		Jaypee	
Item	500 lb/a	750 lb/a	500 lb/a	750 lb/a
Net income, $/a				
Continuous grazing	31.82	39.60	29.06	37.41
Grazing & wheat grain	132.70	135.84	129.57	138.70
Wheat grain	6.33	6.33	9.57	9.57

METRIC TO ENGLISH CONVERSION

Metric	English
Kilogram (kg)	2.2 lb
Meter	3.28 feet
Metric Ton (1000 kg)	2,204.62 lb
27.273 kg	Bushel of wheat (60 lb)
Hectare	2.471 acres
Kg/ha	2.2 lb x 2.471 acres

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