Variety and Species Effects on Forage Quantity, Forage Quality and Animal Performance

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I wish to make a few general statements related to the production and utilization of small grain forage. Since there is also interest in use of tall fescue and ryegrass by some people in the audience, these will be included in some cases.

There are three sets of circumstances in which a cereal crop may be grazed (Holliday, 1956):

1) Grazing only - crop will be grazed out completely without the harvest of a grain crop.
2) Grazing and grain - planted early enough to obtain grazing with animals being removed to permit grain harvest.
3) Grain production - grazing is only opportunistic when forage is excess. May occur when excess vegetation would cause lodging and/or moisture loss.

Southern Great Plains represents a unique set of climatic conditions which permit the production of excess forage. Some other areas of the world graze wheat but not nearly in the magnitude of that in the Hard Red Winter Wheat area.

Acreage of graze-out wheat obviously varies from year to year and the data on number of acres are poor. Production statistics do show acres abandoned and many of these acres are grazed out. In Oklahoma this has a long time average of 18%. Other states also experience some abandonment.

Determination of any acreage planted early for forage is equally elusive. A five year average from 1975-1980 showed the following in Oklahoma:

10% planted by September 12
20% planted by September 20
30% planted by September 27

In years when moisture is favorable, up to 40% of the wheat acreage in Oklahoma can be planted by September 30 (Okla. Agricultural Statistics). A major limitation for early seeding to obtain fall forage is inadequate moisture for early germination and growth. Timely operations (having seed bed ready and planting on limited moisture or dusting in part of the acreage) can improve the potential for fall grazing.

Management for forage production include some practices which can permit high forage production, while permitting the harvest of a grain crop. Early seeding is absolutely essential to obtain high fall forage production and can begin when the soil temperature is 85°F or lower at seeding depth. Increased seeding rate and proper fertility for the expected production is necessary. Overgrazing in the fall can lead to reduced forage and in the spring can reduce grain production. Grazing can be deferred in the fall and forage stockpiled for winter grazing. Problems which may limit early seeding are soil moisture, plant diseases and weed control. Advantages which exist are the reduction in costs of production: different options are available; i. e., a part of the forage can be grazed out in place of taking a grain crop, efficiency of the farm operations can be increased and the risk can be spread over the forage as well as the grain crop.

Species and Varieties

Each species of cool season plants has certain advantages and disadvantages (McMurphy, 1983). Using a mixture of more than one species may extend the grazing season since different species have different periods of production. For example, wheat and ryegrass may provide a better balanced production system than either alone. However, many wheat grain producers do not want their fields contaminated by other species and will use only wheat.

Rye will grow at a cooler temperature and thus will often provide more fall and winter forage than any other small grain. It excels on sandy soils. However, the disadvantages are the very early termination of growth in May and the possibility of volunteer rye in wheat grain fields. Wheat will produce forage for at least two weeks longer than rye in the spring. In the Oklahoma Panhandle with irrigation and a mid-August seeding date, wheat has been just as productive as rye for fall and winter forage. Since wheat has a longer growing season in the spring, it is more productive in the spring than rye. Varietal selection of a wheat is far less important than the cultural practices of early seeding and high nitrogen fertilization for forage production.

Oats are a good forage species for southern Oklahoma, Texas and in other areas where winterkill is not a problem. Ryegrass is a valuable species for southern and eastern areas of the U.S. The big advantage of ryegrass is that growth continues later in the spring long after wheat or rye stops producing forage. Adequate precipitation and mild winter temperatures are necessary for dependable production.

Triticales do not appear to be as productive as other species at this time. They may produce well in some areas but still not produce forage quantities equal to the best wheats.

In the southern part of the region (Fig. 1), oats will produce more total forage than wheat or rye which have very similar yields. Differences among wheat varieties in yield and digestibility are not great (Table 1, Horn, et al., 1981).

As we look across the region climate influences the time of forage production and grazing season. The information obtained in one area may need to be modified for use in another. In this short paper, it is difficult to address these variations adequately.

Tall fescue, a perennial does not have to be planted each year and removes the need for yearly seedbed preparation and planting. Table 2 presents some yields from Muskogee, Oklahoma and the response to added nitrogen fertilizer. Both production and crude protein can be increased with added nitrogen.

Fertilization

Forage containing 25% crude protein (4% N) will have 80 pounds of N per ton of dry matter (McMurphy, 1983). Thus 2 to 3 tons of forage will contain 160 to 240 pounds of nitrogen per acre (Gardenhire and Wilkerson, 1980). If one obtains 70% efficiency of the applied nitrogen, then 230 to 340 pounds of soil and applied nitrogen per acre are needed for forage production. If a grain crop is to be harvested, nitrogen must also be available for the expected yield. When the yield goals are not realized, then the fertilizer application can be adjusted the following year on the basis of the soil test. A soil test is very important to assure that nutrients (nitrogen, phosphorus, potassium) are not limiting production.

Rotation Grazing

No advantage in total forage yield for rotation grazing was realized in the fall and winter months. In spring months, rotation grazing permitted 15 to 20% higher stocking rates and produced more gain per acre than continuous grazing (Elder, 1967). Rotation in the spring permitted more plants to retain their growing points for a longer time period which increased production under graze-out systems.

Fall Stocking Rates

Early grazing or clipping before plant establishment greatly lowered yields. In grazing studies at Muskogee, Oklahoma on small grains mixtures (Fig. 2), heavy (1.2 head/acre) stocking rate gave a 2% increase in gain per acre over a light (0.7 head/acre) rate for November and December (Elder, 1967). Production was lower for the remainder of the season for the heavy stocking rate than for the light stocking rate. In a like manner, early mechanical clipping of forage in the fall months before plants were well established lowered yields greatly.

In grazing studies in Kansas plants from moderately grazed areas had more robust crowns and less top growth than ungrazed plants; however, plants which were severely grazed were much smaller and had fewer tillers than either of the other grazing treatments (Swanson and Anderson, 1951).

Wintering Dry Cows

High quality wheat forage can be combined with dry forage in a limited grazing system for dry cows (Elder, 1967). Data in Table 3 show a grazing pattern in which wheat forage can provide cows their protein supplement--as the winter progresses and quality of dry grass declines, the cows are permitted to graze the wheat more often.

This grazing pattern was adequate to maintain dry cows with a 5% weight loss through the winter and calving which was quite acceptable. In a two year study, cows gained weight in November and December, had a slight loss in January and February, and had the greatest loss in March when the calf was born. Also, calves can be given access to small grains thru creep gates to provide high protein forage to supplement their mother's milk.

Chemical Composition

The cool season forages are some of the highest quality forage available and animal gains are often superior to that obtained on warm season forages. In wheat forage, crude protein content of 25 to 30% are common, calcium and magnesium are low and phosphorus and digestibility is high and rapid. Animal gains of 1.5 pounds per day are obtained for the grazing season with 2.0 pounds possible in spring. Six to eight pounds of forage will often produce one pound of beef gain.

The biological and chemical determinants of quality were measured for a number of forage species in Minnesota at stages where these would be made into silage (Cherney and Marten, 1982). IVDMD ranged from 80% for two varieties of wheat at pre-boot (when the flag leaf collar was about two inches above the collar of the preceding leaf) to 59% at 28 days after head emergence from the boot (Fig. 3). Cell wall constituents 48%, ADF 32%, ADL, 4.6% and crude protein, 17.7% were at acceptable levels. Average mineral contents were K - 2.8%, Ca - 0.56%, P - 0.38%, and Mg - 0.22% (Fig. 4). Individual plant parts were also examined and the leaf blade, the head, and the sheath had higher CP and IVDMD than the stem (Cherney and Marten, 1982b).

Wheat, barley and oat silages were made over a number of years in a study at Kansas (Oltjen and Bolsen, 1978). Wheat and barley cut at the early-dough contained about 60 to 65% moisture and could be ensiled without problems with regard to moisture. Since the cereal stems are hollow and filled with air, fine chopping and good packing were important to exclude entraped air. Table 4 shows that protein content was at an acceptable level and IVDMD was quite good. There were only small differences among the varieties which largely reflected the differences in the maturity. In finishing trials where the small grain silages were compared with corn silage as sources of roughages only small differences were observed in the performance of the animals.

Summary

Wheat forage is one of the highest quality forages which can be produced in the southern Great Plains and is important in livestock systems. Protein content (about 25%) is high in the young plant and is acceptable (about 10%) at a silage stage.

Some management practices are necessary if fall forage is to be produced consistently when moisture is adequate--early seeding, high seed rate, high fertility applications, and proper stocking rate. Grazeout of a portion of the wheat acreage (about 1/3) would have an impact on the grain prices, provide an option on time of sale of animals and provide another means of weed control.

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Table 1. In vitro digestible dry matter (IVDMD) and yield for wheat varieties.

Variety	IVDMD, % 3-18-80	Yield lb/A 11-13-79	Yield lb/A 3-18-80
Newton	74.5a	334bc	933ab
Triumph 64	72.0ab	623a	750bc
Osage	69.9bc	227c	664c
TAM-101	68.4c	280bc	1129a

Table 2. Dry matter (DM) yield and crude protein (CP) for tall fescue in response to fertility levels at Muskogee, Oklahoma.

N	P_2O_5	K_2O	D.M.	C.P.%
------------pounds/acre------------				
0	0	0	1113	9.8
80	40	40	3200	13.6
80	80	80	3289	13.5
160	80	80	4692	16.1
320	80	80	6422	20.2
640	160	160	7310	23.1

Table 3. A winter supplementation program for dry beef cows utilizing small grain as a supplement for dry grass at Stillwater, Oklahoma.

Dates	Ratio of days grazing on Small Grains	to Dry grass
November, December	1	5
January, February	1	4
March	1	3
Total Days	32	118

Table 4. Dry matter (DM), crude protein (CP) and in vitro dry matter digestibility (IVDMD) for wheat silage at 3 stages of maturity in Kansas.

Stage	D.M. %	CP %	IVDMD %
Boot	15.8	15.1	61.2
Milk	30.4	10.5	57.7
Dough	37.5	9.2	57.4

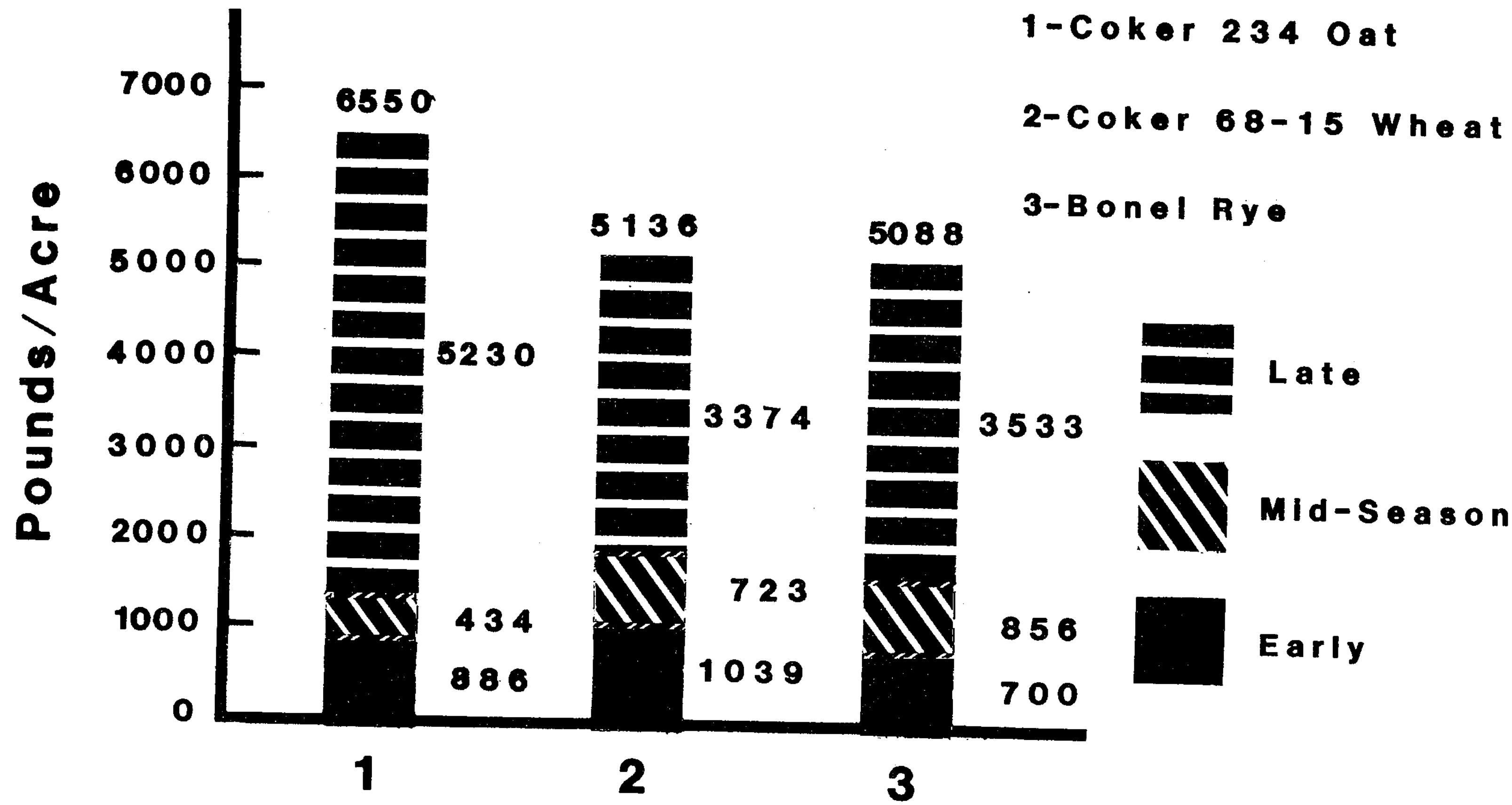

Fig. 1 Yields of wheat, oats, and rye at Dallas, Texas, 1974-78.

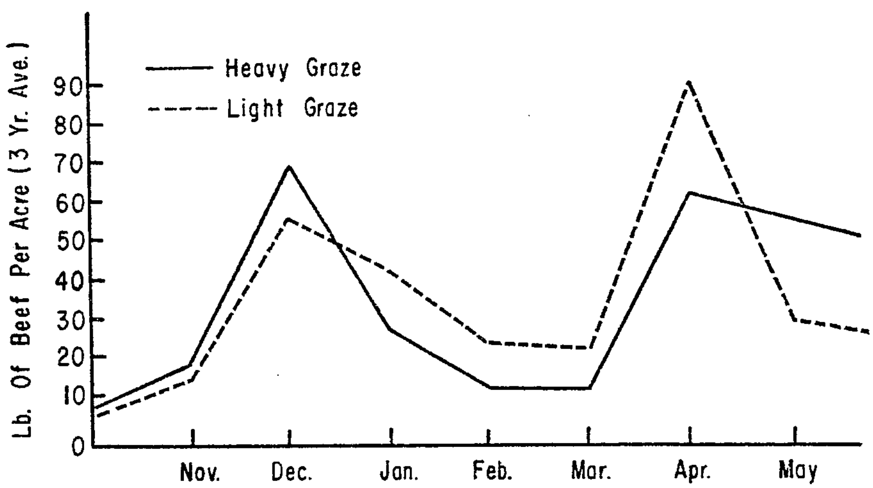

Fig. 2. Heavy stocking rates in November and December lowered stocking rates and beef production for January through April compared with a lighter rate.

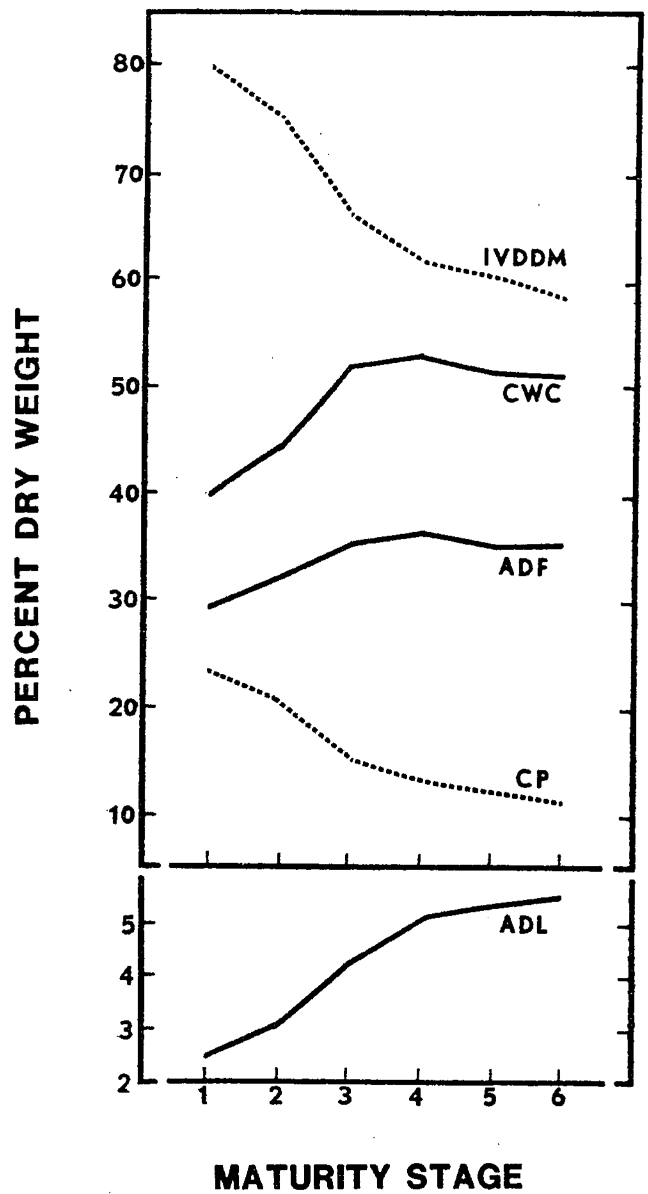

Fig. 3. In vitro digestible dry matter (IVDDM), acid detergent lignin (ADL), crude protein (CP), cell wall constituents (CWC), and acid detergent fiber (ADF) concentration changes for wheat. Maturity stages, (1) collar of flag leaf 2 inches above preceeding collar, (2) spike emergence, (3) 7, (4) 14, (5) 21, and (6) 28 days after spike emergence.

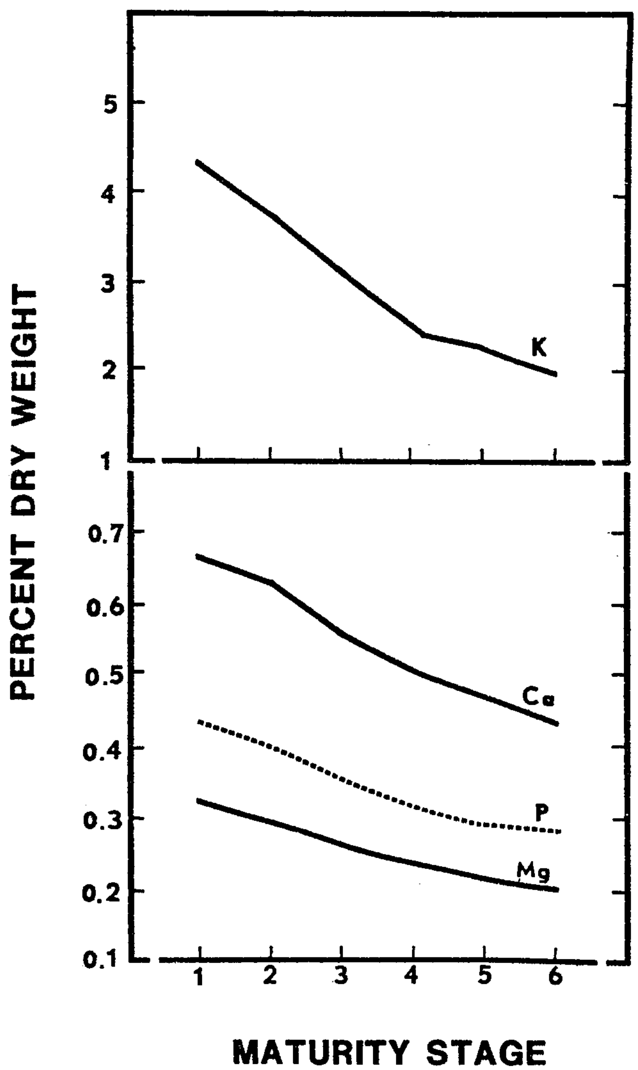

Fig. 4. Potassium (K), calcium (Ca), phosphorus (P), and magnesium (mg) for wheat. Maturity stages as in Figure 3.