Small Grain Silages for New Mexico

Circular 630

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INTRODUCTION

Small grain crops are used extensively in New Mexico for various types of forage production and animal feeding operations. Due to the large influx of dairy facilities into New Mexico and the Texas Panhandle and the extent to which these dairies utilize ensiled feeds, there is a need for an informative guide to assist in management of small grains grown for silage systems. This publication focuses on cool-season, annual cereal crops grown specifically for use in ensiling operations. Small grains used to the greatest extent in New Mexico are wheat (*Triticum aestivum L.*) and triticale (*xTriticosecale*); however, rye (*Secale cereale L.*), barley (*Hordeum vulgare L.*) and oats (*Avena sativa L.*) are used to a lesser extent. All of these species have the potential to fill gaps between summer crops to supply year-round, high-quality feed to meet the constant high nutritional demands of lactating dairy cows. Growing the crops with the intent to sell to nearby dairies gives area farmers a potentially more profitable alternative to grain harvest, depending on comparative crop market values. Small grains also serve as excellent cover crops that help prevent soil erosion and that take up significant amounts of soil nitrogen. Nitrogen uptake is particularly important in conjuncture with the green water land application practices common with dairies. Interest in small grain crops will likely continue to increase as more feeding operations move into New Mexico and as the year-round need to utilize liquid manure persists in this region of the United States.

CROP SELECTION FOR NEW MEXICO

Wheat

Wheat is perhaps the best dual-purpose small grain crop and gives growers the greatest amount of flexibility with harvest and marketing options. Because there are established markets for wheat grain, and storage facilities are readily accessible in the major wheat growing regions of the state, high market prices and good weather conditions have the potential to produce profits in a given year. On the other hand, if grain market prices are low, growers can decide whether it is more advantageous to sell their crop as hay or as silage for dairy consumption. By harvesting early for forage, disastrous weather conditions such as hail, drought or high winds can be avoided, and double cropping becomes a possibility. If a producer has any interest whatsoever in potentially harvesting for grain instead of forage, hard red winter wheats are recommended, as white or soft wheats will not be accepted in traditional marketing channels. Wheat has excellent cold hardiness and can be planted during a large time window in the fall. The majority of forage production occurs in the spring as the plant begins reproductive stages of growth (Figure 1). Although late plantings into October are possible, earlier plantings (e.g., late August/early September) usually result in higher yields and allow for greater productivity for fall grazing. Winter wheat fails to head when planted in the spring unless it is planted early enough that temperatures are cold enough for adequate vernalization. Wheat is more sensitive to acid soils than most of the other small grains and should be utilized on soils with a pH greater than 6.0. This is normally not a problem, as most soils in New Mexico fall into this category. Wheat does not tolerate poorly drained conditions; for best productivity it should be grown on well-drained, loamy soils. In general, wheat has yields higher than winter barley and oats but similar to triticale and rye. In recent years, blends of wheat and triticale have performed better than wheat alone at trials in Clovis. Oftentimes, variation from one variety to the next is greater than the variation between species, and it is important to know which varieties are best adapted to your area. Typical yields of wheat cut for silage (65% moisture) range from 10 to 15 tons/acre. For more information on varietal performance of small grain forages at Clovis, NM access: http://clovissc.nmsu.edu/variety-trials.html.

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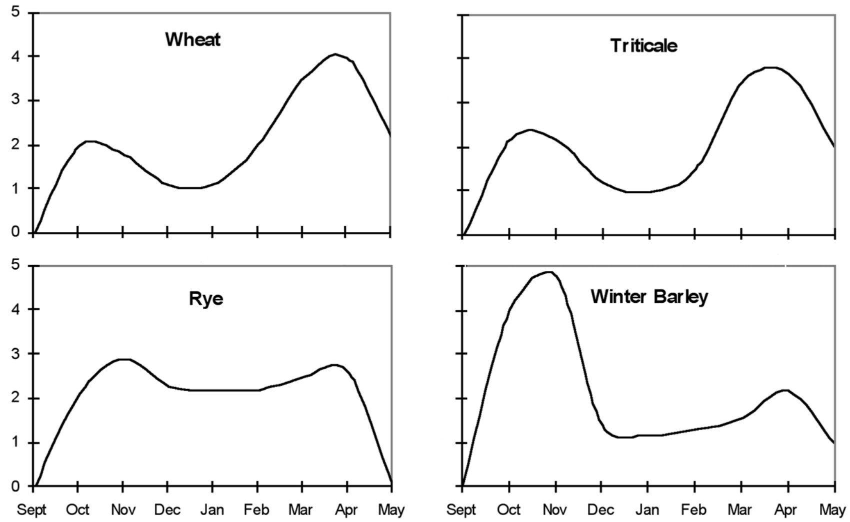

Figure 1. **Relative forage production distribution of small grain crops.**

Triticale

Triticale is a small grain cereal that was developed by crossing wheat and rye. Until recently, triticale was not grown extensively, mostly because of its inferior qualities for baking, compared to wheat. In recent years, however, triticale has increased in popularity among forage growers looking for alternatives to wheat that may provide higher yields, increased nitrogen uptake, and better disease and insect resistance. It is rapidly being realized that triticale can produce large amounts of digestible dry matter while maintaining a nutritive value similar to that of wheat. Triticale has a similar growth distribution to wheat (Figure 1). Because it is a cross between wheat and rye, there is a slight reduction of feeding value associated with triticale. However, varietal differences may have a greater effect than species selection on forage quality, and certainly in-season management has the biggest effect on nutritive parameters. Recent releases of triticale have exhibited yields greater than those of wheat in certain locations of eastern New Mexico and western Texas under irrigation. In these cases, irrigated triticale yielded greater than 15 tons/acre (65% moisture), and some varieties produced as much as 20 tons/acre (http://clovissc.nmsu.edu/variety-trials.html). Triticale varieties that have performed well at Clovis include: SlickTrit, Triplecale and Tamcale. Triticale has larger stems and heads than wheat and usually grows taller. As a result, triticale may require more wilting time at harvest.

Rye

Of all the small grains, rye is the most winterhardy and gives the most uniform growth throughout fall and winter (Figure 1). This makes it best suited for fall and winter grazing, where consistent forage production is required. Rye matures faster than the other small grains, and quality declines rapidly in spring. Contamination of nearby fields that will subsequently be planted to wheat is always a concern with rye; however, if it is grazed out or cut for silage prior to heading, possibility of contamination is greatly reduced. In general, rye silage has higher fiber content and lower digestibility and palatability than wheat, triticale, barley and oat silages.

Barley

Historically, winter barley has been an inferior producer of forage when compared to wheat and triticale. On the other hand, barley produces the most nutritious forage of all the small grain cereals. It is lower in fiber and lignin and is characterized by high crude protein and total digestible nutrients (TDN). Feed value is 90–100% that of corn. Although it produces high quality hay and silage, barley often has low TDN per acre due to its low tonnage. Irrigated trials at Clovis, NM have indicated that when compared with wheat, triticale and blends, barley competes better in dry years than when rainfall amounts are moderate to high. Because of its susceptibility to cold, barley should be planted as early in the fall as possible so that plants will be well established before freezing conditions occur.

Oats

Spring oats are a good option for situations that require rapidly maturing forage production or when wheat productivity is low in spring. Oats have the potential to thicken up weak stands of wheat and will produce more forage than late-planted wheat. Quality of oats is similar to or greater than that of wheat at all growth stages, but yields will be lower (~25–30% less) than from a well-established, fall-planted wheat stand. At boot stage, oat TDN can be 65% or greater. Planting of spring oats should begin as early as possible after soil temperatures reach 45–50°F in the spring. Oats are particularly susceptible to barley yellow dwarf and other viral and fungal diseases. Resistant varieties should be considered, and management of disease hosts and vectors of spread is critical with oats. Some varieties that have performed well in the Southern High Plains region in a one-cut system are Charisma, Chilocco, Magnum, Monida, Troy and Walken (Bean et al., 2001). High cost of oat seed limits its use to a large degree. In some instances, oat seed may cost twice as much as wheat seed.

PRODUCTION

Planting

As with any crop, success at harvest begins with using high-quality seed at planting. For wheat, a minimum test weight of 56 lb/bu and germination of 85% or greater are recommended for proper establishment. Minimum acceptable test weights for triticale, barley, rye and oats should be 50, 48, 56 and 32 lb/bu, respectively. Although cheaper seed is appealing, it can cost more in the long run, and quality of seed can mean the difference between a healthy stand and complete crop failure. For more information on seed quality refer to NMSU Extension Guide A-131, *Certified Seed*, and Guide A-216, *Know What is in a Bag of Seed*. Small grains planted for forage production (grazing, hay or silage) should be planted at rates about 25–30% higher than if planting for grain. For example, if a typical seeding rate for irrigated wheat grain in your area is 90 lb/acre, the corresponding forage rate would be about 110–120 lb/acre. By increasing seeding rate, stem size is reduced, nutritive value is improved, and plants will dry faster and compact easier for ensiling. This is particularly true with triticale, where stems tend be relatively large. For all the small grains, typical seeding rates range from 30 to 60 lb/acre for dryland and from 75 to 120 lb/acre for irrigated crops. Very little improvement in forage yield has been observed with planting rates greater than 100 lb/acre. Another important factor to consider is pest control. Early planted small grains are particularly susceptible to damage caused by various insects (e.g., wireworms, white grubs) and soilborne diseases (e.g., seedling blight). If grazing is not part of the program, it is recommended that planting be delayed until soil temperatures are low enough to reduce soil insect populations. Using seed treated with insecticides and fungicides will greatly reduce the risk of damage from soil insects and soil- and seed-borne pathogens that affect seedling plants. Several products are available for seed treatment, and many are effective on multiple insects and diseases.

Soil Fertility

Prior to planting, a soil test should be taken to assess the fertilizer requirements necessary to grow a high quality silage crop (See Guide A-137, *Soil Analysis: A Key to Soil Nutrient Management*). Small grains respond well to nitrogen applications, and fall tillering and forage production are promoted by adequate phosphorus. In double cropping systems, early plantings allow for uptake of residual nitrogen left in the soil from the previous crop, thereby minimizing leaching of nitrogen below the root zone and reducing waste. Total nitrogen amounts will depend on residual soil nitrogen and intended use of the crop. General recommended rates are 25–50% greater than the recommended 1.5 lb N/bu of expected grain yield, or about 30–35 lb N per ton of dry forage yield (10–12 lb N per wet ton). Fertilizer rates will need to be increased if fall grazing is planned. Split applications are advised, and the majority of nitrogen should be topdressed in spring prior to reproductive growth stages. Although season-long irrigations of effluent water result in consistent application of nitrogen through the plant's life cycle, heavy applications early in the fall and winter (when crop growth is minimal) can lead to significant amounts of N leached out of the root zone and into groundwater resources. Response to potassium fertilizer is not as great as the response to nitrogen and phosphorus, and most New Mexico soils are adequately supplied with available potassium. Occasional deficiencies of sulfur, iron and zinc occur, and appropriate rates of these elements can be determined from soil test results and recommendations.

Irrigation Management

Although excellent yields can be obtained in some years in dryland systems, small grains perform best under irrigation in New Mexico. In most years, yields can be nearly doubled with consistent and appropriately timed irrigation. Surprisingly, some small grains, such as wheat, can use nearly as much water as corn, and evapotranspirational demand can be as much as 30 inches per year. However, total seasonal water requirements typically range from 16 to 24 inches. Crops will use less water at higher elevations and cooler temperatures. Irrigation amounts need to be greater on sandier soils and at more southerly locations in the state. If soils are dry throughout the potential rooting depth (3 to 4 ft) prior to planting, preplant irrigations may be necessary to begin building a good moisture profile for later growth after germination. Profile–filling irrigations are particularly helpful in the spring in order to supply adequate deep water just before rapid growth associated with jointing and later growth stages. A generalized, seasonal water-use curve for wheat is shown in Figure 2. Although water use increases in fall as the plant establishes and tillers prior to winter dormancy, the majority of water use comes in the spring as growth resumes and as the plant reaches the reproductive stage. Peak water use occurs during heading and grain development. From jointing on, adequate moisture is essential, and soil water availability should not be allowed to deplete below 50 percent.

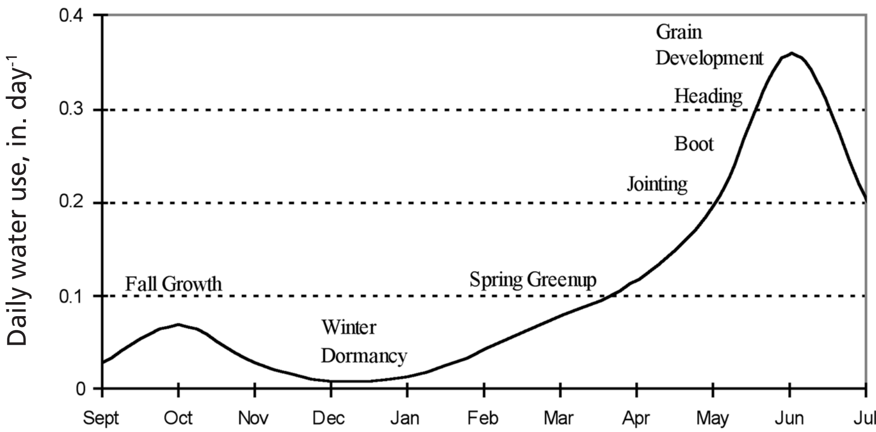

***Figure 2.* Daily water use throughout the life cycle of wheat.** Adapted from: Wheat Prod. Handbook. Kansas State Univ. Ext. Pub. C-529. May, 1997.

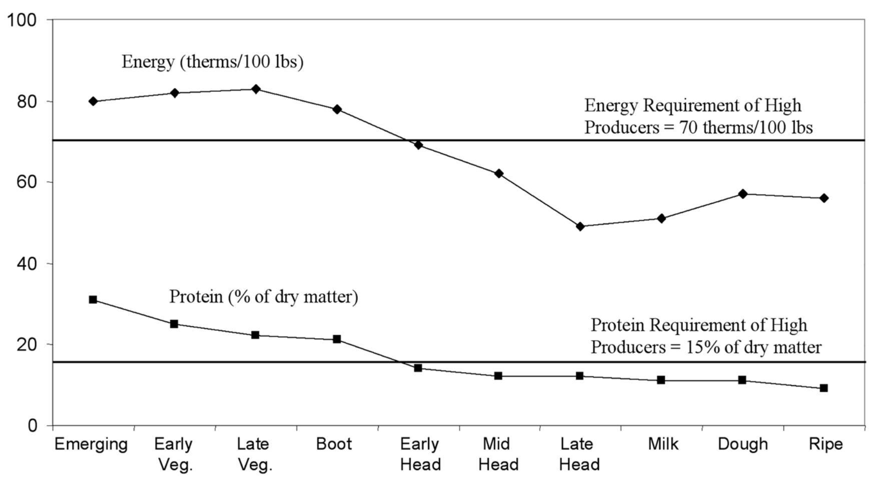

***Figure 3.* Energy and protein content of wheat harvested at different growth stages.** Adapted from: Belyea et al., Wheat Silage for Dairy Cattle. Univ. of Missouri Extension. 1993.

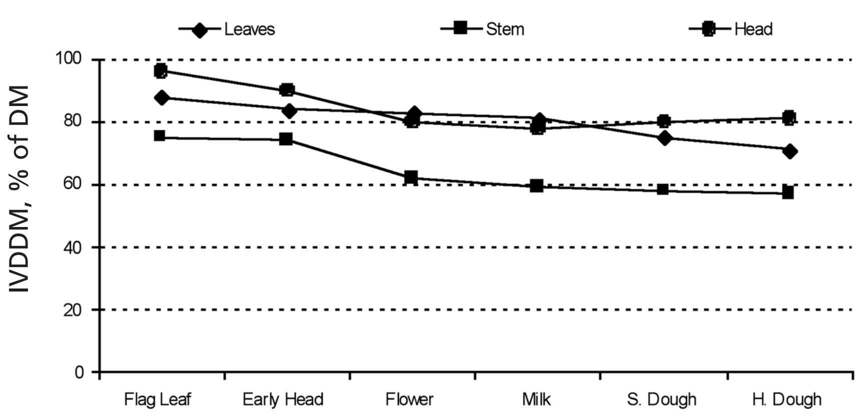

***Figure 4.* In vitro digestible dry matter (IVDDM) of small grain plant parts at various maturities.** Adapted from: Cherney and Marten. 1982. Small Grain Crop Forage Potential. Crop Sci. 22:240-245.

Harvest/Nutritive Value

Under optimum growing conditions, harvest timing of small grain silages has the greatest effect on yield and nutritive value. There are two different trains of thought about the proper time to harvest. Conventional thinking is that late-boot/early-heading is the best time to cut for silage because energy and protein are optimized at this stage (Figure 3). At boot, cereal forages can meet the energy and protein demands of high producing dairy cows. However, after heading both components decline to levels that are too low to meet lactating dairy cow requirements if cereal forages are fed alone. For some dairies, this drop in quality is acceptable because they are adding energy and protein through other forms in the ration, and the small grain silage does not constitute the complete dietary makeup. Silage cut at soft dough and beyond may begin to limit intake rate of digestion as fiber levels increase to unacceptable levels. Small grain silage cut at boot stage contains higher crude protein than corn and sorghum silages, but less energy.

A second argument is that total crude protein and TDN per acre can be greatly increased by allowing the crop to mature to soft-dough stage. This is true because the increase in yield is enough to offset the decline in TDN percent of the field. Yields can be nearly doubled by allowing cereals to mature from boot to soft dough. In New Mexico, where average herd sizes exceed 2,000 head, producers may wish to maximize yield and TDN per acre rather than achieve the highest quality possible at boot. Whatever the case, overall nutritive value of the plant decreases from boot to flowering, and stem, fiber and lignin proportions increase. As the plant matures from flowering to grain filling, a slight recovery in energy occurs, but not to the high level achieved at boot. This is due to highly digestible starch filling the head, and to an increase in head proportion of the total plant (Figure 4). Forage quality is lowest at

Figure 5. **Windrowing oats for wilting to proper moisture content.**

Figure 6. **Tractor leveling and packing silage immediately after truck emptying.**

late heading through flowering, and cutting at this stage is not recommended. Total plant digestibility for wheat at boot, flowering, dough and ripe stages is about 85%, 67%, 72%, and 70%, respectively. Wheat maintains its quality slightly better than triticale throughout maturity.

Small grains harvested at boot stage or earlier will have a moisture content of about 80% and will have to be wilted to a target moisture of 60–65% (Figure 5). Putting up silage with moisture levels of 70% or greater can lead to seepage and clostridial losses. Wilting time will depend on environmental conditions and stage of maturity. Waiting until late dough stages of growth (dry) increases chances of poor ensiling resulting from improper packing and excess oxygen. Small grains have hollow stems and are more difficult to pack than corn and sorghum silages. They should be cut finer (3/8" to 1/2") to ensure an adequate pack and oxygen exclusion. Rapid silo or bunker filling, packing and covering is particularly important with small grain silages (Figure 6). Potential benefits from inoculants are greater with small grain silages than for corn or sorghum silages because microbial populations are often low after winter, and this may be particularly important for silage cut early during cool periods.

CONCLUSION

Small grain forages will continue to increase in importance in New Mexico for years to come. They have the potential to produce large amounts of nutritious forage for multiple types of feeding operations, and can be utilized in many different ways. As information develops, NMSU Cooperative Extension will continue to provide updates on small grain management, and New Mexico County Agent and Specialist resources are always available to provide guidance on this subject.

REFERENCES

Baker, R.D., Ball, S.T. & Flynn, R. (1997). *Soil Analysis: A key to soil nutrient management* (Guide A-137). Las Cruces: New Mexico Cooperative Extension Service.

Bean, B., Rowland, M. & Simmons, J. (2001). *Spring oat variety trial—Texas Panhandle*. Amarillo: Texas Cooperative Extension. Accessed September 1, 2007 at: http://amarillo.tamu.edu/programs/agronomy/publications/Other/OatSummary2001.pdf

Bean, B. & Trostle, C. (2006). *Considering spring planted oats* (Pub. 5192). College Station: Texas Cooperative Extension.

Belyea, R.L., Ricketts, R.E. Martz, F.A., Ruehlow, R.R. & Bennett, R.C. (1993). *Wheat silage for dairy cattle* (Pub. G3260). Columbia: University of Missouri Extension.

Cherney, J.H. & Marten, G.C. (1982). Small grain crop forage potential. *Crop Science*, 22:240-245.

Ditsch, D.C., & Bitzer, M.J. *Managing small grains for livestock forage* (Pub. AGR-160). Lexington: University of Kentucky Cooperative Extension.

Glover, C.R. (1996). *Certified seed* (Guide A-131). Las Cruces: New Mexico State University Cooperative Extension Service.

Glover, C.R. (1996). *Know what is in a bag of seed* (Guide A-216). Las Cruces: New Mexico State University Cooperative Extension Service.

Mask, P.L., Ball, D.M. & Moss, B.R. (1994). *Wheat silage production guide* (Pub. ANR-528). Auburn: Alabama Cooperative Extension.

Oelke, E.A., Oplinger, E.S. & Brinkman, M.A. (1989). “Triticale” In *Alternative Field Crops Manual*. Madison: University of Wisconsin Cooperative Extension, and St. Paul: University of Minnesota Extension Service.

Rayburn, E.B. (1995). *Small grains as forage crops.* Morgantown: West Virginia University Extension Service.

Rogers, D.H. (1997). Irrigation management. In *Wheat Production Handbook* (Pub. C-529). Manhattan: Kansas State University Cooperative Extension.

Watson, S.L., Fjell, D.L. Shroyer, J.P. Bolsen, K. & Duncan, S. (1993). *Small grain cereals for forage* (Pub. MF-1072). Manhattan: Kansas State University Cooperative Extension.

NOTES