Millets for Forage and Grain in New Mexico and West Texas

Guide A-417

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INTRODUCTION

The term "millet" is applied to various warm-season annual grass crops around the world that are grazed or harvested for hay or as grain for human food or animal feed. In New Mexico, as well as West Texas, the majority of millet (hybrid pearl and foxtail millet) is grown as forage and is capable of producing high-quality feed in a short amount of time and with minimal inputs. Millets are similar to sorghum forages in their productivity and feed value. There are several advantages of millets over sorghum when grown for forage, including no prussic acid potential as well as tolerance of high pH/caliche soil conditions that induce iron deficiency. (For a detailed comparison of these two crops, see the **PEARL MILLET – SORGHUM-SUDANGRASS COMPARISONS** section of this guide). When used as grain, millets are considered a cereal, but in the United States they have lost a great deal of importance in favor of other cereal crops, such as wheat, sorghum, or rice. Millets are generally considered minor crops elsewhere, except in India, Africa, and China. Compared to other cereal grains, millets are well suited to less fertile soils and poorer growing conditions, such as intense heat and low rainfall. In addition, their rapid growth and shorter growing seasons make millets ideal for emergency, late-planted, and double cropping situations.

This publication will concentrate on the description and management of the most important summer annual millet species grown primarily for forage that are adapted to New Mexico and West Texas, as well as proso millet, which has potential in cooler regions of New Mexico.

***Figure 1*. Pearl millet grown under dryland conditions at Tucumcari, NM.**

MILLET SPECIES

Pearl millet (*Pennisetum glaucum* L.), also called cattail millet, bullrush millet, or candle millet (Figure 1), is generally used as a temporary summer pasture, hay, or silage crop and is one of the most widely grown millets in the region. This species is leafy, but tall and erect, often growing from 3 to 8 ft in height. It is particularly well adapted to nutrient-poor, sandy soils in low rainfall areas. Stems are pithy and leaves are often wide, long, and pointed, with finely serrated margins. Pearl millet plants tiller freely and produce an inflorescence with a dense, cylindrical, spike-like, brownish panicle 14 in. long and 1 in. or less in diameter. Pearl millets

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Figure 2. **Foxtail millet (German Strain R) after heading at Tucumcari, NM.**

are generally cross-pollinated, and several high-yielding varieties and hybrids have been developed. Seed from pearl millet has been used for poultry feed and birdseed in the U.S., but can potentially be used for other classes of livestock. Both forage and seed type pearl millets are available for purchase. Forage types typically grow taller and produce less grain. In general, grain maturity will occur sooner than grain sorghums (milo). The protein content and amino acid profile of pearl millet grain makes it a very suitable feed for the poultry industry.

Foxtail millet [*Setaria italica* (L.) Beauv.], also called German or Italian millet (Figure 2), is one of the oldest cultivated crops in the world and is the other more commonly grown millet in the region, although acreage is less than pearl millet. Foxtail millet forms slender, erect, leafy stems varying in height from 1 to 5 ft. Small convex seeds are enclosed in hulls (whose color depends on variety) and are borne in a spike-like, compressed panicle resembling yellow, green, or giant foxtails.

Foxtail millet requires warm weather and matures quickly in the hot summer months. Generally grown in semiarid regions, it has a low water requirement, though it does not recover well from drought conditions because it has a shallow root system. Successful production is due almost entirely to its short growing season (65 to 70 days for hay types; 75 to 90 days for grain types). Consequently, foxtail millet can be planted when it is too late to plant most other crops.

Principal uses of foxtail millet include forage for hay or grazing or grain for birdseed. Several different types of foxtail millet are grown in northern New Mexico and southern Colorado (mostly as hay crops), but some are used for dual-purpose hay and grain production. Although some cool-season hay crops are superior in quality, foxtail millet makes good hay for cattle and sheep, but it has generally been displaced by sorghum-sudangrass hybrids as a late-sown summer hay crop (see Guide A-332, *Sorghum Forage Production in New Mexico*, available from http://aces.nmsu.edu/pubs/_a/a-332.pdf).

Proso millet (*Panicum miliaceum* L.), also called broomcorn millet, hog millet, or Hershey millet (Figure 3), is grown as a grain crop primarily for birdseed and for brooms. It is adapted to regions where spring-sown small grains are successful and moderately warm weather is necessary for good plant growth. Proso millet has one of the lowest water requirements of

***Figure 3*. White proso millet at Tucumcari, NM.**

any grain crop, but it is also subject to drought injury because of its shallow root system and does not grow well on coarse, sandy soils. Proso millet can be planted following most other crops because it often requires only 60 to 75 days from seeding to maturity, and is generally grown as a late-seeded, short-season summer catch crop.

Varieties of proso millet are divided into three groups based on the shape of the panicle: (1) spreading, (2) loose and one-sided, and (3) compact and erect. Generally, this millet has a large, open panicle with coarse, woody stems 12 to 48 in. high. Seed are larger than those found on foxtail millet. They are enclosed in the inner chaff or hull, which ranges in color from white to black, with reds, browns, and grays. The large, erect stems and leaves are covered with hair. Several varieties are available and are utilized to a moderate degree in New Mexico, but to a much larger extent in Colorado. Varieties grown in New Mexico include Earlybird, Huntsman, Sunrise, and Sunup.

MILLET CULTURE

Planting. Millets are very sensitive to cold temperatures and should only be planted when the threat of freeze has passed in the spring. Even temperatures of 40 to 50°F can severely hinder growth; they are more sensitive than sorghums in this regard. Millets do not germinate in cool, wet soil, so it is necessary to delay planting until soils have thoroughly warmed (consistent, daily minimum soil temperature of 65°F or higher at the 1-in. depth). As a general rule of thumb, millets should be planted 3 to 4 weeks after typical corn planting time or 1 to 2 weeks after sorghum for a particular area (e.g., millet planted between May 15 and 20 or later for the Clovis, NM, area). Millets may be seeded at any time that will allow at least 60 to 70 days of growing season until frost. Yields will be reduced if planting takes place too late. Most millets are planted in much the same manner as small grains, using drills with 6- to 8-in. row spacing (wider-spaced drills may allow weed competition). Standard grain drills with a small seed attachment (alfalfa box) are best for seeding due to the small size of some millet seed. Seeding depth ranges from 1/2 to 1 in. It is important not to plant millets deep in conventionally tilled ground because heavy rains can bury seeds even deeper and cause soil crusting, thereby leading to poor emergence. No-till planting is possible, but the shallow planting depth necessary for millets may be difficult to achieve with large amounts of residue on the soil surface. In addition, no-till soils generally are cooler than conventionally tilled soils, and planting later in no-till situations is advised. In conventional systems, soil preparation should follow recommendations for producing small grains or sorghum. Later planting usually gives adequate time for thorough land preparation. A fairly level, moist, firm seedbed is recommended, and soils should be weed-free prior to planting.

Common seeding rates of millets range broadly from 5 to 30 lb/ac, but adequate yields for pearl and foxtail millets can be obtained under irrigation with 15 to 25 lb of seed/ac (drilled). Proso millet is often seeded at 20 to 30 lb/ac. Seed cost per acre will be higher than for sorghums planted at similar rates for forage. It should be noted that excellent forage yields (>5 tons/ac) have been obtained with late-planted pearl millet in West Texas with as little as 5 lb of seed/ac. Millets have the ability to tiller quite extensively and fill in open spaces in the stand caused by poor emergence or plant damage. In general, higher seeding rates may be warranted if seed is broadcast or to help hasten canopy closure in order to better compete with weeds. Higher

seeding rates are also recommended when hay crops are desired in order to minimize stem size and increase nutritive value. Dryland seeding rates are roughly half of those of irrigated plantings. When producing millet for grain crops, seeding rates should be reduced by half or more, and millet should be planted in wider rows (e.g., 30 in.) to allow cultivation since herbicide options are limited.

Fertilization. Millets are grown and can be productive on less fertile soils, but they respond well to nitrogen (N) and phosphorus (P) fertilizers. Generally, 40 to 80 lb N per acre at planting is adequate for both forage and grain. Total N requirement will depend on water status (i.e., dryland or irrigated) or irrigation amount to be applied. If used for multi-cut hay or grazing, an additional 40 to 60 lb N/ac should be applied after each cutting or intensive grazing event. One-cut hay or silage systems will require a total of 150 lb N/ac or more for high yields (roughly 25 to 30 lb N/ac per dry ton of yield). Phosphorus should be applied based on soil test results, but 30 to 60 lb P/ac is usually adequate to produce hay or grain. Potassium in most New Mexico and West Texas soils is adequate to meet the demands of millet crops. A soil test is recommended to evaluate the entire nutritional needs of the crop, including micronutrients. Millets perform better and are less susceptible to iron deficiency than sorghums on high pH, calcareous soils that are common in New Mexico and Texas.

Pest (weeds, insects, and diseases) Control. Integrated pest management (IPM) should always be used in millet production, whether it is grown for forage or grain. Choosing a particular control method or methods (cultural, mechanical, or chemical) depends upon the pest spectrum, crop rotation sequence, and other factors. Cultural control options include using weed-free seed of an adapted variety, narrow row spacing for forage production, and crop rotations, all of which will enhance the competitive edge of the millet crop. Mechanical methods should be used to control established weeds and prepare the seedbed prior to planting millets. If the seedbed is adequate for planting, existing weeds can also be controlled with burndown herbicides such as glyphosate or paraquat, which have no soil residual activity. Additionally, saflufenacil has a supplemental label for use as a burndown herbicide from early pre-plant through pre-emergence for pearl and proso millets. Care should be taken with this herbicide since injury may occur under certain soil conditions and for some millet varieties. Where millets are planted in wide rows for seed or silage, mechanical cultivation can provide in-season weed control if herbicides are not available or capable of being used. The most troublesome weeds in millet production are summer annual broadleaf and grassy weeds.

Chemical weed control options are limited for millet production. Currently, only mesotrione (Callisto) is labeled for pre-emergence broadleaf weed control in pearl millet; however, saflufenacil (Sharpen) has some soil residual activity and may provide limited control of certain broadleaf weeds. These products must be applied prior to millet emergence. A few post-emergence herbicides can be used on millet (pearl millet mainly) for broadleaf weed control. These include 2,4-D formulations, fluroxypyr (Starane), and carfentrazone (Aim). Most of these herbicides can be applied up to the early boot stage of millet growth. Prosulfuron (Peak) is labeled for post-emergence use on proso millet only. No herbicides are labeled for grass weed control after millet has emerged. Available herbicides vary in their specificity for use on either forage or grain crops or both. **When using any agricultural pest control product, always consult and follow label directions for appropriate rates, application procedures, and pre-harvest intervals.**

In general, insects are not a major pest of millets. The principal insect problems in millet production are grasshoppers on young plants and fall armyworms feeding on whorl-stage pearl millet plants. In some cases, chinch bugs or false chinch bugs may also cause economic damage. Grasshoppers, thrips, and grass mites may become a problem on most millets as they move from maturing wheat into millet fields. Corn earworm and stink bugs occasionally feed on pearl millet heads. Several insecticides are labeled for use on millets. Foxtail millet can harbor the wheat curl mite, a vector of wheat streak mosaic virus in wheat. Therefore, wheat should not be planted following production of foxtail millet unless sufficient time has passed to break the curl mite cycle (3 weeks or more).

While numerous diseases have been reported for millets worldwide, diseases generally are not widespread in New Mexico and West Texas, especially when millet is grown for forage. Some diseases affecting foxtail millet include mildew, bacterial blight, and leaf spot. Kernel smut is also a problem in some cases, but can be controlled with seed treatments. The impact of head smuts that affect grain quality can be reduced with high-quality seed and planter box fungicide treatments. Diseases are not prevalent on proso millet, but bacterial stripe, kernel smut, and head smut are occasional problems and can be controlled with seed treatments and crop rotations. Producers should only buy certified seed for planting. There appears to be few disease problems associated with pearl millet in the region; however, bacterial leaf spot has been observed on pearl millet in New Mexico. This disease rarely causes economic damage. If millets are planted into cool, wet soils early in the season, damping off may occur to seedlings. Seed rots can be controlled with fungicides applied as a seed treatment at planting.

Figure 4. **Pearl millet being swathed after heading for hay. Later-maturing sorghum-sudangrass is present in the background. Although pearl millet was harvested at a later stage of maturity, nutritive value of the two crops was similar in 2010.**

As with sorghum grown for grain, birds can be a major pest of millets. The exposed grain heads are easily accessible, and significant damage can be done to crops, especially on small acreages near structures or tree lines and when harvest is delayed. Potential losses associated with bird feeding should be weighed when considering planting millets for grain or silage (early grain development).

Harvesting. Forage crops can be utilized as early as 45 to 60 days after planting. Hay crops should be windrowed at the boot stage for a good balance of yield and nutritive value. If hay is cut at later stages of development (Figure 4), nutritive value will be lower but yields will likely be higher. First cut yields of pearl millet grown with irrigation can be as high as 3.0 to 4.5 tons/ac when cut as hay at the boot stage. Subsequent harvests generally will yield less than the first. Total seasonal yields can exceed 7 tons/ac of dry forage in irrigated multi-cut systems. While multiple cuttings are possible in most parts of the region, cooler regions at higher elevations in New Mexico may be limited to only 1 or 2 cuttings per year. Pearl millet has been shown to yield twice as much forage as foxtail millet in trials conducted at Clovis, NM, and it has the added advantage of regrowth after cutting. Foxtail millets will not grow much, if at all, after harvest; therefore, these millets work well as single-cut smother crops. It is often thought that pearl millet will yield slightly less than sorghum-sudangrass forages; however, yields have been comparable in tests conducted at Clovis and Tucumcari, NM (for more information on variety performance, see the corn and sorghum performance tests at http://aces.nmsu.edu/pubs/variety_trials/welcome.html#corn).

Pearl millet averages 60 to 65% digestibility and 14 to 18% crude protein when harvested prior to heading. In general, nutritive value of millets is slightly higher than sorghum-sudangrass hybrids grown for hay, mainly due to the greater proportion of leaves (i.e., less stalk) of millets. The brown midrib trait (BMR; i.e., less indigestible lignin) may be available soon in pearl millet and, like sorghum, should give higher digestibility than conventional types. Nutritive value of foxtail millet will be similar to that of pearl millet, but perhaps slightly

higher due to lower yields. Foxtail millet can be dangerous to horses in large quantities due to a glucoside known as setarian that can damage kidneys, bones, and joints. Hence, foxtail millets should only be fed to cattle and sheep. Cutting hay early may lessen this danger, and hay cut prior to heading is preferred for horses. Foxtail millets may also cause oral lesions when consumed. Pearl millets do not contain the cyanogenic glucosides (or prussic acid potential) common in sorghum and, thus, can be fed with less concern of harming livestock. However, alkaloid accumulation in some foxtail and pearl millets has been reported and may become toxic to livestock, including horses. The lack of prussic acid potential makes millet more suitable than sorghum for grazing under drought or frost conditions. However, like other forages, millets may accumulate nitrates, and nitrate toxicity can be a concern when the crop is used for grazing or hay. For more information on nitrate toxicity and how to manage high-nitrate feeds, see Guide B-807, *Nitrate Poisoning of Livestock*, available from http://aces.nmsu.edu/pubs/_b/b-807.pdf.

Grazing of millets should be delayed until plants are about 12 to 18 in. tall. Plants should not be grazed lower than 6 in. if regrowth is desired. If plants reach the boot stage or 40 in. tall, they should be cut for hay or silage. At this stage, plants will contain over 75% moisture. Hence, they will need to be windrowed and wilted slightly (down to 65% moisture) prior to chopping for silage or allowed to dry to less than 18% moisture prior to baling. Pearl millets have large stalks and may therefore be difficult to dry. Using a conditioner at cutting will help facilitate drying and prevent dry matter losses, excessive heating, and molds associated with baling wet hay. Laying the hay out in a wide swath will also take better advantage of solar radiation to promote curing, although this technique will require raking prior to baling.

Because seeds do not mature uniformly and shattering of early-maturing seeds can occur, proso millets grown for grain are generally windrowed when seeds in the upper half of the head are ripe and allowed to cure before combining with a pickup header. Several of the proso millets mature at or near 1,500 growing degree days (using 50°F and 86°F base and maximum temperatures, respectively). Average protein content of most foxtail and proso millet grain ranges from 11 to 12%, compared to around 13% for wheat. Protein content of pearl millet grain is equal to or higher than that of corn and sorghum and has a higher concentration of essential amino acids. Pearl millet can be harvested with a combine similar to grain sorghum when grain moisture is below 15%. Minimal, but critical, combine adjustments will be necessary for the smaller seed size and difficulty of separating seed from the head. A desiccant may be necessary prior to harvest because leaves and stalks may still be green well after grain maturity. Storage moisture should not exceed 12% to prevent molds from developing.

PEARL MILLET – SORGHUM-SUDANGRASS COMPARISONS

Advantages – Pearl Millet

- Leaf/stem ratio of pearl millet tends to be >50/50 in contrast to sorghum-sudangrass, which is usually <50/50. This has potential implications for forage quality because leaves are more digestible than stems. Nutritive value of pearl millet has been similar to BMR sorghums in variety testing at Clovis, NM. Crude protein is typically higher for pearl millet.
- Millet is not a member of the sorghum family and does not develop prussic acid during sudden regrowth after drought conditions or upon the first fall frost/freeze; thus, grazing cattle may not need to be removed or withheld. However, millet is susceptible to potential nitrate accumulation and poisoning like many other forages. Similar environmental stresses are responsible for accumulations of both of these toxic substances.
- Pearl millet is suitable forage for horses, whereas sorghums are not recommended for grazing or feeding to horses due to potential for cystitis (a urinary tract disease).
- Millet (at least hybrid pearl) has a different iron uptake mechanism than do members of the sorghum family, which are highly susceptible to iron deficiency and chlorosis. Millet can withstand high pH soils and caliche conditions without yellowing up (iron chlorosis) better than forages in the sorghum family. This does not mean that all millets are immune to iron deficiency.

Disadvantages – Pearl Millet

- Seed is small (70,000 to 90,000/lb), about 1/5 the size of sorghum-sudangrass seed (and about 1/3 to 1/4 of sorgo-sorghum-sudan, or three-way cross forage). This means that it cannot be drilled or planted as deeply as sorghum.
- Millet can be harder to establish in dryland due to more shallow seeding depth and limited moisture in the seeding zone that can dry out quicker.
- Relative to sorghum-sudangrass, hybrid pearl millet cannot be grazed as hard; pearl millet resources often suggest to leave at least 6 to 8 in. of stubble after grazing (or haying) in order for adequate regrowth, which is a couple of inches more than commonly suggested for sorghum-sudangrass.

- Millet has fewer herbicides labeled for use than sorghum-sudangrass; see the previous section on pest control. For a list of currently available herbicides labeled for millet, go to http://www.cdms.net, click 'Services,' then 'Labels/MSDS,' and then 'Other Search Options.' Register a user name and password, then sign in. You can select Product Type (enter 'herbicide' in the scroll down menu) and then Crop/Site (enter 'millet'). This will call up all labels that have millet on them. (Note that atrazine is not labeled for hybrid pearl millet.)

CONCLUSIONS

Millets can be a valuable source of forage because of their rapid growth, high nutritive value, and ability to survive stressful conditions such as drought. These crops fit well into rotational systems and in situations where growing seasons are short or when emergency summer forage is needed. Proper harvest timing is critical to achieve maximum feed value for animals requiring high nutrition. For classes of livestock with lower nutritional demands, harvests can be delayed in order to maximize yield. Millets can also do well on soils that are not conducive to growing sorghum or corn, and they do not contain prussic acid that sorghum forages accumulate. Finally, millets can be harvested as grain for specialty human foods or bird seed.

FURTHER MILLET, FORAGE, AND CROP RESOURCES

For more information about managing millets for forage or grain in New Mexico and West Texas, contact your county Cooperative Extension Service office. Other information about managing forages can be found at the resources page of NMSU's forage website (http://forages.nmsu.edu/resources.html), and general information about grain production can be found at NMSU Cooperative Extension Service's agronomy publications website (http://aces.nmsu.edu/pubs/_a/).

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