

AGRON--GRAM

June, 1987

We continually get requests for information on millet production. Bob Croissant and John Shanahan have written a paper on "Proso and Foxtail Millet Production," which should answer many of these questions. John Shanahan and Dan Smith have provided some information on the certification of forage testing laboratories. They have included a list of labs that are certified to test forages. Because of the frequent questions we get on phosphorus fertilizers, Hunter Follett has included in this newsletter a paper on "Phosphorus Fertilizer Materials." Also included in this letter is some information on the corn Referendum.

The Colorado State Agricultural Field Day will be on July 21, 1987. We are quite excited about this field day because for the first time it will be a joint effort of five departments: Agronomy, Entomology, Plant Pathology and Weed Science, Agricultural and Natural Resource Economics, and Agricultural and Chemical Engineering. The program for the field day was sent out with the Pest Alert Newsletter. Additional programs will be mailed out in the near future. Make plans to attend this field day if your schedule permits.

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PROSO AND FOXTAIL MILLET PRODUCTION
R. L. CROISSANT AND J. F. SHANAHAN¹

ECONOMIC IMPORTANCE

The millets, grown world wide, are important as a source of human food, livestock feed and, most recently, marketed and processed as bird seed. Only three types of millet are common in Colorado; proso, foxtail and pearl. The grain from proso is used for livestock feed or in bird seed mixtures. Foxtail millet is primarily used for hay and sometimes bird seed, while pearl millet is used for hay and grazing. Only the proso and foxtail types will be included in this publication. Pearl millet production is discussed in SIA .109.

DESCRIPTION

Proso Millet (*Panicum milaceum*) is sometimes referred to as hogmillet, hershey or broomcorn millet. Proso is an annual warm season grass which produces an inflorescence which is a large open-branching panicle like oats. The plant produces coarse hollow stems, growing to about 30 inches in height. The stems and leaves are covered with short hair. When the grain is threshed, most of the seed remains enclosed in the inner hull (lemma and palea). Seed color varies with varieties and is typically white, creamy white, yellow or red. However, it may be shades of brown, gray or black. The proso is self pollinated, but some out-crossing may occur when two varieties are planted side by side.

Foxtail Millet

Foxtail millet, *Setaria italica*, is an annual warm season grass with slender leafy stems up to 40 inches tall. The inflorescence is in dense cylindrical bristly panicles. The inner hulls covering the threshed seeds may be white, yellow, orange, or other various shades including green and purple. Like proso, foxtail millet is highly self pollinated, but may show some out-crosses when different varieties are planted side by side.

Climatic Requirements

Proso millet is a short season crop requiring 50 to 90 days from sowing to maturity for early to mid-season varieties while foxtail millet requires 55 to 70 days to reach a stage suitable for hay and 75 to 90 days for seed production.

Both millet types require relatively warm weather for germination and plant growth. Optimum soil temperatures for seed germination are between 68 and 86 degrees F (20 to 30 degrees C). They do not mature well under cool fall weather conditions. Under favorable conditions, millet grows slow the first few weeks after planting.

Proso millet has a very high conversion rate of water into grain. This is attributed in part to a low straw to grain ratio (1:1 for Common White) and to a small leaf area. Studies at Akron, CO, indicate

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that proso yields grain after only six inches of total water use. Whereas, winter wheat, barley, oats and grain sorghum require 9 to 10 inches of total water use before initiation of grain production. Data from Shantz, H.L. and L.N. Piemiesel shows proso millet having a very low transpiration ratio (Table 1).

Table 1. Transpiration ratio (T-R) of various crops¹.

Crop	T-R ²	Crop	T-R
Proso millet	267	Sunflower	577
Sorghum	304	Oats	583
Corn	349	Soybeans	646
Sugar Beets	377	Dry Beans	700
Wheat	557	Rape	714
Cotton	568		

¹Shantz, H.L. and L.N. Piemiesel. 1927. Akron, CO

²Grams of water transpired per gram of above ground dry matter.

The composition of millet grain types as compared to other feeds is shown in Table 2.

Table 2. Average composition of various grains as compared to millet.

Feed	Average Composition, Percent				
	Protein	Ether Extract	Crude Fiber	Nitrogen Free Ext	Ash
Corn	8.7	3.9	1.7	70.9	1.2
Millet, Foxtail Grain	12.1	4.1	9.0	61.6	3.2
Millet, Pearl Grain	11.9	4.5	2.0	68.6	2.0
Millet, Proso Grain	11.8	3.6	7.0	65.0	2.7
Sorghum, Grain	11.0	2.8	2.0	71.6	1.7
Wheat	12.7	1.7	3.0	70.0	1.6

Taken From: Crampton, E.W. and L.E. Harris. 1969. Applied Animal Nutrition. W.A. Freeman and Co., San Francisco.

Hay

Foxtail millet is usually grown for forage and is harvested at the late boot to late bloom stage. Harvest consists of swathing followed by a short curing period, and baling or stacking. The composition of foxtail millet relative to other forages is shown in Table 3.

Table 3. The average composition of foxtail millet hay and its comparison to other hay crops.

Feed	% Protein	Ether Extract	Crude Fiber	Nitrogen Free Ext	Ash
Foxtail Millet Hay	8.3	2.6	25.8	43.8	7.2
Millet, Pearl Hay	8.0	1.8	31.6	37.6	8.9
Oat Hay (Full Bloom)	7.9	2.6	28.1	39.9	5.8
Sudangrass (Full Bloom)	9.1	2.0	25.7	41.4	8.5

Taken From: Crampton, E.W. and L.E. Harris. 1969. Applied Animal Nutrition. W.A. Freeman and Co., San Francisco.

The grain from foxtail millet is normally used only for seed but grain of good color and high test weight is also used for birdseed. As with proso, foxtail millet grain does not require processing when fed to fowl but should be ground or rolled when fed to other classes of livestock.

Cultural Practices

Both millet types are usually grown under dryland conditions. When planted on loamy textured soils, the land is usually rotated with fallow and wheat. On sandy soils, many growers do not summer fallow for millet. Millet is a shallow rooted crop and will extract most of its water requirements from the 0- to 3-foot soil depth.

Common tillage tools used in the dryland wheat producing areas of eastern Colorado are adapted for proso and foxtail millet production. A one-way disk plow, disk, chisels, or sweeps followed by a rod weeder can be used, depending on the amount of stubble, weed growth and previous crop.

A grain drill is nearly always used to seed millet. It may be necessary under dry soil conditions to plant rather deep; however, the seed should never be covered by more than one inch of soil.

Rate of Seeding

If millet is planted for seed in row culture (30-inch row spacing), seeding rates of 2 to 4 pounds per acre for both proso and foxtail types is common. When proso millet is planted with a grain drill, seeding rates of 8 to 15 pounds per acre are recommended. Fifteen viable seeds per square foot of 90 percent germination seed is equivalent to 9 pounds per acre, while the 25 viable seeds per square foot of the same seed lot would be equal to 15 pounds per acre. When planting in poor seedbeds and/or heavy expected weed pressure, higher seeding rates are sometimes used.

Foxtail millet, containing approximately 220,000 seeds per pound, planted at 6 pounds per acre will provide 30 seeds per square foot of row. This seeding rate is adequate under ideal conditions, although many producers seed up to 30 pounds per acre. However, some planters do not have adjustments which permit seeding rates as low as 6 pounds per acre.

Fertilization

Nitrogen is generally the most important limiting nutrient. Soils where millet and small grains have been grown in a continuous sequence probably will respond to additional nitrogen. Fields where millet is produced after fallow may be less likely to respond to additional fertilizer. Nitrogen recommendations are based on the nutrient supplying ability of the soil as determined from a soil test. To determine amounts to apply, refer to Table 4.

Table 4. Nitrogen recommendations for dryland millet.

NO ₃ -N Soil Test ppm	1-2 Percent M (Hard Land Soils)	0-1 Percent OM (Sandy Soils)
0-6	40	50
7-12	20	30
13-18	0	10
19-24	0	0
>24	0	0

Phosphorus is the second most limiting nutrient under Colorado conditions. Application of phosphorus fertilizer should be based on soil test recommendations. Table 5 provides guidelines for additional phosphorus applications on millet. Responses can be expected when phosphorus is applied with small amounts of nitrogen.

Table 5. Phosphorus recommendations for dryland millet.

Phosphorus(P) Soil Test ppm	Fertilizer Phosphorus lb/A P ₂ O ₅
0-3 Low	40
4-7 Medium	20
>7 High	0

Recent research supports phosphorus band application below the seed as being superior to broadcast applications. Drill row application of nitrogen fertilizer is not recommended.

Proso Millet Varieties

Abarr - Abarr is a selection from Common White released by the Colorado Ag. Exp. Sta. It is a large white seeded type. Matures in 60 to 70 days from planting. Desired by the birdseed trade. Abarr grows about 36 inches tall and does best on medium textured soils, is higher yielding and more uniform than Common White.

Cerise - Cerise is a light red-seeded early maturing proso released by Nebraska Agricultural Experiment Station in 1974. Cerise is a medium height cultivar with fair lodging resistance. The seed is medium sized with high test weight.

Cope - Cope is a proso selected from Common White released by Colo. Ag. Exp. Sta. It is 10 to 14 days later in maturity than Abarr. Seeds are large and white. Cope has good straw strength, is 25 to 35 percent taller than Abarr and has some variability in head type. On the average, Cope will outyield Abarr by more than 30 percent.

Dawn - Dawn was developed by the Neb. Ag Exp. Sta. Dawn is a short millet with a tight panicle 7 to 10 days earlier than Panhandle (about the same maturity as Cerise and Turghai). It ripens uniformly and is more resistant to shattering and lodging than Panhandle. It has a large white seed and may be direct-harvested rather than swathed because of its short stature and early maturity.

Leonard - Leonard was derived from germplasm material from Afghanistan and was released by the Colorado Agricultural Experiment Station in 1968. Leonard is yellow to tan seeded and because of its color is not in demand by the birdseed industry. It is a consistent high yielder and under irrigation will grow to almost 5 feet tall. It matures 2 to 3 weeks later than Abarr. Leonard is very leafy and tillers well. Leonard shows more response to improved cultural practices than other proso millets and should be seeded at 5 to 8 pounds per acre.

Rise - Rise, a white seeded proso, was developed at the Neb. Ag. Exp. Sta., and is 5 to 7 inches taller than Dawn. It has a tight panicle similar to Dawn and is of medium maturity.

Turghai - Turghai, a light red to orange seeded proso type early maturing, high test weight variety that has excellent resistance to lodging. It has an open spreading panicle, plants are mid-tall to tall and is early maturing. It can often be swathed after 60 to 70 days and is capable of producing good yields.

Foxtail Millet Varieties

Butte is a late maturing foxtail millet selected from a bulk population obtained from the USSR and released by the Colorado Agricultural Experiment Station in 1975. Butte is a medium height variety with good lodging resistance. It has small yellow seed of low test weight.

German R. is a fine stemmed leafy strain with compact distinctly lobed heads. At maturity, the bristles on the compact cylindrical heads tend to be reddish purple and change to straw colored at maturity. It matures too late to produce seed in northeast Colorado.

Golden German - is a selection from material maintained by J.J. and David (son) Deschamps for over 30 years. The variety was released by Colorado State University in 1968. It is a shorter, finer stemmed variety than White Wonder. The heads may reach six inches in length and are slightly lobed. The bristles exceed the spikelet in length and are golden brown at maturity. The rounded seeds are deep yellow in appearance.

Manta - Manta is a selection of the Siberian type made by South Dakota. It is an early variety growing to about 36 inches tall. The seed color is orange. Plants of Manta are not as leafy as Golden German.

Sno-Fox is a late maturing, medium height foxtail millet developed by Nebraska Agricultural Experiment Station and released in 1980. It has poor lodging resistance and small white seeds of medium test weight.

White Wonder - White Wonder is a dual purpose millet that can be used for either hay or grain. The seed color is white to light yellow. The plant is tall (up to 50 inches), has a coarse stalk, and stands well. The head is long and distinctly lobed. The cultivar is late maturing and may produce seed in areas east and south of Akron.

Harvesting

Proso - The suggested method of harvest for proso millet is swathing when the seeds in the upper half of the panicle have matured. Seeds in the lower half of the panicle may still be in the dough stage, but should have lost their green color. At this point, there may or may not be some green color in stems and leaves. Swathing too soon reduces yield, test weight and color. Swathing too late increases losses due to shattering and lodging.

Foxtail - Foxtail millet for hay should be harvested in the late boot to bloom stage. At this growth stage, hay quality is highest with 12 to 14 percent protein levels being common. As the plant matures, percent protein is expected to decline about 30 percent by late bloom. Delayed harvest will increase the bristles in hay and may cause lump jaw and sore eyes in cattle feeding from bunks. Forage protein can be managed by maintaining optimum levels of soil nitrogen.

Foxtail millet for seed production should be left uncut until completely ripe, then swathed and combined. Some growers are direct combining foxtail millet after a killing frost and accepting shattering losses.

Diseases and Pests

Head Smut (*Spacelotha destruens*) and kernel smut (*Ustilago crameri*) of proso millet may occasionally be encountered in Colorado. Head smut of proso millet is easily controlled by seed treatment with organic compounds but kernel smut is more difficult to control. This disease requires seed treatment plus crop rotation for effective control, as the inoculation will remain in the soil for several years. Neither disease is widespread in Colorado.

Proso millet apparently does not harbor the wheat curl mite but foxtail millet is known to host this insect. This means that foxtail millet can be a vector for the spread of wheat streak mosaic. Cutting foxtail for hay by early August and then undercutting the stubble should destroy the crop acting as host required for the mite and reducing the chance for fall wheat infection.

Under certain conditions, proso seedlings do not root properly. Although no experimental evidence is available, it appears that dry hot conditions with elevated soil temperatures are the cause. When dug up, the seedling has the seminal root from the seed to the crown and all secondary roots developing from the crown are short and club shaped. These roots fail to penetrate the dry soil surface. The condition seems to correct itself following a rain.

Weed Control

In the seedling stage, millet is a poor competitor with weeds. Complete tillage prior to seeding will reduce the problem significantly. Atrazine may be applied to proso millet either preplant or pre-emergence at 0.5 to 2.0 pounds AI/A. Use the lower rates on soils with less than 2 percent organic matter. Beware of atrazine carryover when rotating to other crops. Atrazine will damage foxtail millet and, therefore, cannot be used for weed control with this species.

Feeding Foxtail Millet

Foxtail millet hay fed to cattle is an excellent feed and produces satisfactory rates of gain. Foxtail millet should not be fed as the only roughage to horses. Foxtail millet hay acts as a laxative and diuretic. Hay cut from young plants appears to produce a more pronounced laxative effect and mature or overripe hay the most diuretic.

Occasionally when foxtail millet is severely stressed, nitrate levels may build up in the forage to levels toxic to livestock. If there is any doubt about the safety in feeding, the forage is easily tested and diluted to safe levels. See SIA 1.610, Nitrate Poisoning in Livestock, for more information.

Grazing millet is not recommended although it may be grazed in emergencies. Millet does not root firmly during early growth and is easily pulled up from the soil by grazing livestock. Regrowth is very slow following grazing.