

Proso Millet in North Dakota

A-805 (revised), July 2007

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Types and Uses of Millet

The most common types of millet grown in North Dakota are proso millet (*Panicum milaceum*) and foxtail millet (*Setaria italica*). Foxtail millet is grown primarily for hay. Other types of millet that occasionally may be grown in North Dakota are pearl millet (*Pennisetum glaucum*) and Japanese millet (*Echinochloa crusgalli* var. *frumentacea*). Pearl millet is used extensively in the southeastern United States as a forage crop, and Japanese millet, a close relative of barnyard grass, sometimes is grown for forage.

Description

Proso millet, also called proso, grain millet or hog millet, is grown primarily for feed grain or birdseed purposes. The annual proso grain millet acreage in North Dakota has ranged from 9,000 to 28,000 acres in the past 10 years. Proso is a warm-season grass and is well-adapted to the warm summer temperature of the northern Plains. It is, however, sensitive to frost and therefore usually is planted in June. Proso is a relatively short-season crop and in North Dakota will mature 70 to 100 days after planting. The time required for maturity will vary with variety, planting date and summer temperatures. Proso has a shallow root system, but because of its short growing season, the water requirements for proso are less than for most other crops. Proso often is used as a catch crop for situations where other crops have failed, been hailed out or never were planted due to unfavorable weather conditions.

Seeding Date

Suggested seeding dates for proso millet grain production in North Dakota are June 1 to June 25. Seeding after June 25 is considered risky for most sections of the state except the southeastern corner. In the southeast, proso has been planted successfully until about July 4, but stands are more difficult to establish and grain yields are usually less than at earlier seedling dates. Seeding for forage production may occur until mid-July. Millet for forage production will require about 50 to 65 days from emergence to harvest. Low-disturbance no-till seeding methods will preserve available moisture and improve germination and establishment in midsummer plantings. Proso seedlings establish best after soil temperatures reach 65 F at the 1-inch seeding depth.

Seeding Rate

Recommended seeding rates for proso millet are 20 to 30 pounds of pure live seed per acre. Proso millet contains about 80,000 seeds per pound and adequate stands often have been obtained with seeding rates as low as 10 pounds per acre. The higher seeding rates are suggested because millets are relatively poor competitors with weeds and are noted for their poor seedling vigor.

Planting Suggestions

Proso millet should be seeded at a depth of about 1 inch in a firm seedbed. In tilled and high-disturbance no-till seedings, packer wheels on the drill or air seeder will increase seedbed firmness and assist with stand establishment. Tillage prior to seeding should be designed to establish a firm, weed-free seedbed. On fields prone to crusting following rain and prior to seedling emergence, immediate replanting may be the best technique for successful stand establishment. Low-disturbance no-till seeding maintains a firm seedbed as well as moisture for germination and plant growth while reducing factors that lead to crusting. When setting drilling depth, consider crop residue and duff layer thickness. The slot created by the opener still needs to be sealed with press wheels to maintain moisture levels in the seed zone.

Proso Millet Variety Performance

Several good proso millet varieties are adapted to North Dakota growing conditions, although seed of a particular variety may not always be available. Seed dealers often list red proso or white proso and do not specify variety. Certified seed directories in Minnesota, South Dakota

and North Dakota are good references for millet seed. Birdseed contractors usually specify the color and in many cases even the variety they want produced. To assist with variety selection, the agronomic characteristics are described below.

Cerise - Red proso. Very early. Medium tall height. Fair lodging resistance. Small, orange seed of high test weight. Released by Nebraska Agricultural Experiment Station in 1974.

Rise - White proso. Medium maturity. Short. Fair lodging resistance. Medium size with white seed of medium test weight. Released by Nebraska Agricultural Experiment Station in 1983.

Sunup - White proso. Good yield potential. Its plant height is greater than Rise. It has good stem strength. Maturity is medium and similar to Rise. Its parentage is Dawn and Rise. Released by Nebraska Agricultural Experiment Station in 1989.

Earlybird - White proso. Early. Large seeded, medium early maturing with plant height slightly shorter than Sunup with good straw strength. Released by Nebraska Agricultural Experiment Station in 1995.

Snowbird - White proso. Early medium maturity with an open panicle. Yields have been less than Sunup or Rise. Released by Minnesota Agricultural Experiment Station in 1989.

Dawn - White proso. Very early and short. Fair lodging resistance. Medium size with white seed of medium test weight. Released by Nebraska Agricultural Experiment Station in 1976.

Sunrise - White proso. High yielding, large seeded, midmaturing cultivar. It has good straw strength, short plant height and exhibits good test weight. It was developed cooperatively and released by the University of Nebraska and U.S. Department of Agriculture-Agricultural Research Service in 1995.

Horizon - White proso. High yielding, large seeded, midmaturing line. It has fair straw strength, short plant height and good test weight. It was released in 2002 by the University of Nebraska Agricultural Research Division.

Huntsman - White proso. Large seeded, late maturing variety. Yield performance, test weight, plant height and straw strength are similar to Sunup. It was developed cooperatively by University of Nebraska and USDA-ARS in 1995.

Minsum - White proso. Early. Medium height. Poor lodging resistance. Large, white seed of medium test weight. Open heads with long, spreading branches contrast with more compact heads of other white proso varieties. Released by Minnesota Agricultural Experiment Station in 1980.

Turghi - Red proso millet of medium height with good lodging resistance. Maturity in approximately 60 to 70 days after planting. It has an open, spreading-type panicle. Introduced from Russia or Siberia in the early 1900s and was grown extensively in the 1920s. It still is being grown in some instances because of its hardiness.

To assist with variety selection, the agronomic characteristics are summarized in Table 1, and agronomic performance in Tables 2, 3 and 4.

Table 1. Proso millet varieties.

Variety	Seed Color	Plant Height	Maturity	Seed Size
Cerise	red	tall	early	small
Earlybird	white	short	medium	large
Rise	white	short	medium	medium
Snowbird	white	medium	medium	large
Sunup	white	short-medium	medium	large
Dawn	white	short	early	medium
Sunrise	white	short	medium	large
Huntsman	white	short-medium	late	large
Minsum	white	medium	early	large
Horizon	white	short	medium	large

Table 2. Proso millet variety performance at NDSU Carrington Research Extension Center, Carrington, N.D.

Variety 2005	Grain Yield 3-yr. Avg. lb/ac	Seed	Days to	Plant	Plant	1,000	Test		
		Color	Head	Height	Lodge	KWT	Weight		
				inch	0-9	grams	lb/bu		
Cerise		Red	48.5	53.7	4.5	5.6	55.1	2,052	1,730
Earlybird		White	53.5	56.4	4.3	6.7	51.8	2,121	1,909
Horizon		White	54.5	52.1	2.8	7.2	52.6	2,163	1,739
Huntsman		White	54.8	58.6	1.8	7.1	52.4	2,131	1,839
Sunup		White	52.5	52.9	3.5	6.3	52.1	2,732	2,114
Turghi		Red	48.8	53.1	2.5	5.8	55.8	2,380	1,848
MEAN			52.1	54.5	3.2	6.46	53.3	2,263	—
C.V.%			1.5	2.7	33.3	5.3	1.1	8.9	—
LSD.05			1.2	2.3	1.6	0.52	0.9	304	—

Planting date in 2005: June 20; previous crop = spring wheat
Swath date = Aug. 26 ; harvest date = Sept. 30

Table 3. Proso millet variety performance at NDSU Williston Research Extension Center, Williston, N.D.

Cultivar 2005	Heading Date	Plant Height	Test Weight	Grain Yield			
				2003	2004		
3 yr. avg.	Days after Planting	Inches	lbs/bu	lbs/ac			
	lbs/ac						
Dawn	47	29	56.2	◆	1,147	1,996	—
Earlybird	48	28	54.2	496	1,467	1,460	1,141
Horizon	51	28	55.2	437	1,583	1,692	1,237
Huntsman	52	29	54.1	419	1,437	1,399	1,085
Sunrise	50	28	54.6	475	1,447	1,496	1,139
Sunup	48	32	55.2	◆	1,473	1,099	—
MEAN	49	29	54.9	457	1,372	1,524	—
CV %	1	8	0.6	28	17	12	—
LSD 0.05	1	NS	0.9	NS	NS	284	—

Planting date: June 6, 2005, on fallow

Harvest date: Sept. 9, 2005 

Table 4. Proso millet variety trial at the NDSU Hettinger Research Extension Center, Hettinger, N.D.

- Average Yield - Variety yr	Days to Head	Test Weight	Grain Yield			2	
			2002	2003	2004		
3 yr		Lbs/bu	Pounds per acre				
Horizon	82	50.2	1,867	2,900	1,553	2,226	2,107
Sunup	80	45.1	1,600	3,067	1,520	2,294	2,062
Huntsman	78	45.0	1,960	2,560	1,427	1,994	1,982
Minsum	77	50.4	1,289	2,027	1,933	1,980	1,750
Earlybird	81	43.5	1,073	2,620	1,253	1,936	1,649
Sunrise	80	41.9	960	2,787	1,147	1,967	1,631
Rise	79	46.9	640	2,353	1,400	1,876	1,464
Snowbird	77	48.3	980	1,780	1,393	1,586	1,384
Turghai	76	52.9	693	1,447	1,653	1,550	1,264
Cerise	77	50.8	280	1,289	1,640	1,464	1,070
Dawn	78	48.6	507	1,813	853	1,333	1,058
Trial Mean	79	47.6	1,121	2,262	1,434	◆	—
C.V. %	1.2	5.5	20.6	9.4	19.4	◆	—
LSD .05	1	3.8	335	308	402	◆	—

Planting date: May 25, 2004

Harvest date: Sept. 27, 2004

Seeding rate: 25 lbs/acre

Previous crop: 2001 = oat, 2002 and 2003 = barley.

Soil Fertility

Proso yields on low-fertility soils generally are increased by fertilization. Nitrogen (N) is generally the most important nutrient limiting high millet grain yields. Nitrogen recommendations should be based on the nutrient-supplying ability of the soil as determined by a soil test. All proso millet varieties will lodge, so excessive levels of applied or residual soil nitrogen should be avoided. Drill row applications of N fertilizer may cause injury and are not recommended except for straight phosphorus materials. Refer to NDSU Extension publication [SF-726](#) for detailed information on fertilizing millet.

Weed Control

In the seedling stage, proso millet is a poor competitor with weeds, and all weeds should be controlled by tillage or glyphosate immediately prior to planting. Roundup (glyphosate) may be applied any time up until emergence of the crop. A timely application of glyphosate used in combination with a low-disturbance no-till drill will reduce competition from weeds during establishment. Proso becomes more competitive with weeds after it reaches a height of 6 to 8 inches. In-crop herbicide options for weed control in proso millet are limited to 2,4-D, Aim, dicamba, MCPA and Peak. Check labels because not all 2,4-D brands carry proso millet on their recommendations. Broadleaf weeds can be controlled postemergence with 2,4-D amine at 0.25 to 0.6 pound active ingredient per acre (0.5 to 1.3 pints of 4 pounds-per-gallon concentrate) when the millet is 4 to 6 inches tall. Do not apply 2,4-D when millet is heading or flowering. Dicamba (various brands) can be used to control broadleaf weeds in proso millet. Application during the two- to five-leaf stage is suggested. Peak also is labeled for use on proso in mixed combinations with MCPA or dicamba. Aim may be applied from emergence to jointing. Refer to the herbicide label for application details, as well as grazing and haying restrictions. Proso may be injured if planted on land previously treated with dinitroanilines (trifluralin, Sonalon or Prowl) or similar herbicides. Atrazine no longer is labeled to be used on millet for weed control.

Insects, Diseases and Other Pests

Proso millet is remarkably free from disease and insect pests. Seed treatment with a protectant type of fungicide, such as Thiram, will reduce the infection by the head smut (*Sphacelotheca destruens*) spores in the soil and also may increase seedling survival. Most years, head smut is not a serious problem in North Dakota. Apron XL LS is a seed treatment option that will control Pythium damping-off and downy mildew control in seedlings. Regular crop rotation is thought to reduce incidence of seedling blights and root rot diseases in North Dakota. Grasshoppers have been the most serious insect problem. The insecticide Sevin (various formulations of carbaryl) is approved for use on millet to control grasshoppers and also can be used to control army worms. Corn borer has been reported to cause some damage and yield losses in proso millet.

Rodents and birds often cause severe damage to proso during the ripening stage. Rodent and bird control programs similar to those used on other crops are suggested.

Harvesting

Proso millet can shatter easily if allowed to become too mature prior to harvest. Swathing is the suggested method for millet harvest, and should begin after seeds in the upper one-half of the panicle have matured. Seeds in the lower portion of the panicle still may be in the dough stage but should have lost their green tinge. The stems and leaves of the plant usually still are green. Swathing too soon reduces yield, test weight and color quality. Cutting too late will increase losses due to shattering and lodging. Combining can be delayed until the proso millet grain is below 13 percent moisture. Proper setting of the combine is important for proso millet grain harvest. Cylinder speed should be about 20 percent slower than for wheat harvest, or about 850 rpm. The biggest problem in marketing proso millet grain is when the hulls have been removed during threshing and only the yellow inner berry is left. A good rule of thumb is to leave as many of the loose outer glumes on as the number of hulls removed. Millet cut for hay should be harvested when the crop is in the boot to milk stage.

Storage

Proso seed should be stored at 13 percent moisture or less. If drying millet after harvest is necessary, follow the same precautions suggested for small grains. Batch dryers have been used successfully for drying millet.

Marketing and Utilization

No federal grain standards have been established for millet, but test weights of 52 to 56 pounds per bushel (lbs/bu) are considered good. Good quality proso millet should be free from various types of kernel damage, including dehulling, and a musty smell, and it should not contain excessive amounts of weed or other crop seed.

Millet for birdseed purposes often is grown under contract. Large, bright white or red seed is preferred and premiums sometimes are paid for superior quality. Two types of birdseed mixes are marketed. One type is for wild birds and the other type is for cage birds. The cage bird mixes require the better quality proso and premiums often are paid to obtain this type of seed. In recent years, a growing demand for top quality, hulled, white proso millet seed for human consumption also has developed.

Proso millet ranks with most other cereal grains as an energy source. It has many of the nutritional characteristics of the cereal grains, including certain amino acid deficiencies (Table 5).

Producers planning to utilize proso millet in livestock rations should contact their nutritionist. Proso millet is low in calcium, several B-complex vitamins and essential amino acids. Fortification of diets containing proso millet will be required for adequate livestock growth and performance.

The primary nutrient deficiency is its low lysine content. Lysine is an essential amino acid. Nonruminants (swine and poultry) cannot manufacture their own lysine, so their diets must be formulated to meet all their needs. Failure to supply adequate lysine reduces the growth of swine and poultry. Rations for nonruminants always will require lysine supplementation.

The phosphorus in proso millet is approximately 50 percent for nonruminants. Supplementary inorganic or other highly available phosphorus is required. Also, as with other cereal grains, additional calcium will be required to meet calcium requirements and provide a proper calcium-to-phosphorus ratio.

Table 5. Average composition of proso (on as-fed basis).

Nutrient	Content	Nutrient	Content
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Crude protein	12.0 percent	B-complex vitamins:	
Crude fiber	8.0 percent	thiamine	3.0 milligrams/lb
Ether extract (fat)	4.0 percent	niacin (nicotinic acid)	10.5 mg/lb
Total digestible nutrients	75 percent	riboflavin	1.7 mg/lb
Digestible energy	1500 kilocalories/lb	pantothenic acid	5.0 mg/lb
Calcium	0.05 percent	Choline	200.0 mg/lb
Phosphorus	0.30 percent	Critical amino acids:	
Carotene	none	Lysine	0.23%
Vitamin D	none	Methionine	0.29%
Vitamin B ₁₂	none	Threonine	0.40%
		Tryptophan	0.17%

Beef Cattle

Grind or process millet to break all kernels, but do not powder. Breaking all kernels by rolling is difficult. A hammer mill with a 0.25-inch screen will produce a satisfactory product.

NDSU trials, where crude fiber levels were comparable, showed proso millet, barley, corn and wheat to be equal as an energy source in finishing rations. An NDSU trial comparing proso millet and barley for fattening steer calves showed equal daily rate of gain and feed efficiency. Nebraska research reports that proso millet can replace up to half the corn in high-grain diets without reducing gains or feed conversion. Likewise, a Kansas study showed a substitution of up to 28 percent of the milo grain in a finishing steer diet, with proso millet actually improved daily rate of gain.

Cattle started on a diet containing only proso millet take longer to reach full feed than calves started on oats. Using a small amount of hay (1 to 2 pounds) also helps cattle consume large amounts of proso millet.

Dairy Cows

Dairy cows receiving ground millet as 40 percent of their grain mix produced as much milk and made an increase in body weight slightly greater than pair-mated cows fed equal amounts of oats, corn or barley. In a second trial, similar results were obtained.

Sheep and Lambs

Lambs may not like proso millet as well as corn. Proso might best be combined with another feed grain. Grind proso millet coarsely for lamb feeding, similar to the grind for cattle.

Early Colorado experiments indicated proso millet equals corn or barley for lambs. A Minnesota study showed ground proso millet to be superior to whole millet in a fattening lamb diet. South Dakota studies also showed grinding proso millet coarsely was necessary for best lamb performance. As an energy source, it was essentially equal to corn, barley, hard red spring wheat or durum in lamb-fattening rations.

Horses

CAUTION

Feeding millet hay or grain to horses should be avoided because it contains a glucoside called setarian, which causes considerable kidney irritation and excessive urination by horses.

Swine

A series of trials at NDSU studying nutritional characteristics of proso millet have pointed to low-quality protein as the primary nutritional limitation of this grain for hogs. When the protein quality deficit was corrected, proso millet-fed hogs performed similarly to those fed other balanced cereal grain rations.

Early trials at NDSU showed pigs performed better on half-and-half mixtures of proso-barley or proso-corn than on full proso diets. Pigs receiving only proso millet ate less per day, gained more slowly and had lower feed efficiency.

These trials show proso millet can be used as the major grain in swine rations if the protein quality of the ration is corrected by additional lysine (Table 6). To keep the level of lysine supplementation moderate, barley is probably the best cereal grain to blend with proso millet for swine rations. Proso-oat combinations are undesirably high in fiber for growing-finishing hogs.

Table 6. Performance of 30-pound pigs fed two proso millet diets containing 6% soybean oil meal.

	Proso millet control diet (lbs)	Proso millet + 0.33% L-lysine (lbs)
Weight gain 56 days	37.6	62.0
Average daily gain	0.67	1.07
Feed/lb gain	5.29	3.30
Final weight	68	90

Forage Use

Forages from proso millet are recognized as palatable, high-quality feedstuffs for ruminant animals by producers who have fed them.

Both millet hay and straw are very useful materials for cattle and sheep, but not for horses. Digestibility studies at NDSU have substantiated the higher protein and energy value of proso millet straw, as compared with oats, barley or wheat straws. Millet straw frequently contains as much as 7 percent protein, some 44 percent of which is digested by cattle, compared with only 10 percent digestibility of protein and only 4 percent total protein found in oats, barley and wheat straws.

Millet straw contains 39.5 percent acid detergent fiber, about three-fourths the level of fiber found in oats, barley and wheat straws. Millet straw provided 10.5 percent more digestible energy per pound of dry matter than oat straw and 16 percent (one-sixth) more digestible energy per pound than barley and wheat straws. Digestible energy value determined for proso

millet straw fed as two-thirds of the ration was 2.10 megacalories (Mcal) per kilogram (Kg) or 0.95 Mcals per pound of dry matter. Feeding proso millet hays as 100 percent or half of the diet for pregnant heifers supports slightly greater fetal development than a control ration containing half corn silage, a fourth alfalfa-bromegrass hay and the remainder oat straw.

Conclusions and Recommendations

Protein quality level of proso millet-based rations must be raised for growing-finishing swine. Proso millet contains only about 0.23 percent lysine. For practical purposes, consider corn and proso millet about equal in lysine content. Consequently, similar amounts of supplementation are required for the two grains for swine.

Using the amounts of supplement suggested by reputable feed manufacturers for use in corn rations should give satisfactory results with all proso millet rations. Disregard the higher crude protein content of proso millet because its amino acid content, not its crude protein level, is the most limiting factor in utilizing proso millet in rations for nonruminants. When proso is combined with barley, oats or hard red spring wheat, adjust supplement levels downward to a point intermediately between that suggested for corn- and barley-based rotations. Always include a vitamin and trace mineral source, as well as amino acid supplementation. Note other nutrient shortages for swine rations in Table 5.

Grinding proso millet is best. A 0.25-inch screen is best for cattle and sheep and a 0.187-inch screen for swine rations. Farmers who feed millet most successfully ordinarily use it in combination with other cereal grains at not more than half the grain mix. Oats and barley are used most commonly. Properly supplemented, millet can be an economical and fully satisfactory source of energy for livestock on North Dakota farms.

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